

**Understanding how Grade 11 Life Sciences teachers mediate biodiversity
concepts in a second language context: A case study**

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ZINGISA GQOLOQA

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Declaration

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.

Signature: Date.....

ZINGISA GQOLOQA

Abstract

This research focused on an investigation of the pedagogy and strategies used by Grade 11 Life Sciences teachers when mediating Biodiversity concepts with English second language learners. My interest in this investigation was triggered by the Examiners' Reports for Life Sciences from 2009 to 2012 which consistently noted learner challenges in answering, interpreting and analysing questions during exams. The reports highlighted learners' lack of understanding of the questions which led to them providing irrelevant information in their exam scripts. These reports claimed that challenges experienced by these learners could be attributed to language issues experienced by English second language learners.

Influenced by these reports, a qualitative case study of two Senior Secondary schools in East London, Eastern Cape South Africa was conducted. Underpinned by an interpretive paradigm and driven by the desire to achieve an in-depth understanding of the case under study, three phases of information gathering were followed. The first phase was that of gathering information through document analysis. Documents were analysed to gain insights and understanding of the issue before conducting interviews. The next phase was that of gathering information through semi-structured interviews followed by classroom observations. Findings from these observations were verified through stimulated recall interviews which provided clarity on the intentionality of choosing a certain method and strategy over another when assisting learners in making meaning of biodiversity concepts.

The main findings of this study are that factors which limit learner understanding of biodiversity concepts are a result of a combination of factors such as failure to interpret questions, spelling problems which alter meaning of concepts and an inability to make distinctions among closely related concepts within the topic of Biodiversity. Responding to these factors, teachers demonstrated knowledge of a variety of teaching strategies to support learners. The choice of teaching strategies seemed to be guided by their experiences as well as the challenges they often encounter. Furthermore, teachers' reflections on their practice provided opportunities for them to identify strengths and limitations of their choice of strategies and possibilities for improvement.

It was also noted that factors such as large class sizes, gaps in content knowledge and a lack of detail in chalkboard summary limited the effectiveness of their teaching strategies.

The study recommends that:

- Teacher-learner ratio needs to be considered for effective support;
- There is still a need to capacitate educators in environmental education. In-service training should focus on developing teacher understanding of foundational knowledge in life sciences; and
- Teachers need to improve their chalkboard summary skills to increase the level of support that could be provided by comprehensive chalkboard summary through the elaboration of ideas.

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Dedication

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List of abbreviations and acronyms

CAPS	Curriculum and Assessment Policy Statement
C2005	Curriculum 2005
DoE	Department of Education
EECI	Environmental Education Committee Initiative
LoLT	Language of Learning and Teaching
NATED 550	National Assembly Training and Education Department
NCS	National Curriculum Statement
OBE	Outcome Based Education
UNESCO	United Nations Educational, Scientific and Cultural Organisation
PCK	Pedagogical Content Knowledge
T1	Teacher 1
T2	Teacher 2

Chapter 1: Context and background

1.1 Introduction

The main aim of this study was to understand how Grade 11 teachers mediate biodiversity concepts for English second language learners. My research interest was triggered by Examiners' Reports in Life Sciences from 2009-2012 which consistently described learner challenges in answering, interpreting and analysing questions during exams. These reports claim that the issues described could be directly attributed to language challenges experienced by English second language learners (DoE, 2009-2012). I became interested in finding out more about how Grade 11 educators mediate learning with second language learners, focusing in particular on biodiversity as a topic.

This chapter presents the introduction of my study focusing on the following aspects: the background of the study, the context of the research, methodology, and the significance of the research. The chapter ends with overview of the thesis.

1.2 Background of the study

In South Africa, it has been observed that there is a high rate of underperformance in science-related subjects. For instance, the statistics on learner performance in Life Sciences for students who achieved more than 40% indicate a slight increase from 39,9% in 2009 to 43,4 % in 2012 (DoE, 2012). Science subjects have generally been identified as 'killer' subjects in some schools as they have a negative effect on the overall results and pass rate in schools (Wellington & Osborne, 2001).

As a grade 12 Life Sciences teacher, this rate of underperformance in the sciences has concerned me greatly. Although I am by no means underestimating socio-political factors that affect learner performance and that may contribute to the success or failure of students in this regard, I cannot help but wonder if the teaching strategies we are using are suited to quality learning in Life Sciences in particular.

Not surprisingly, UNESCO (2005) sees the teacher as playing a vital role in influencing learning, achievement and success. They argue that in the mediation of concepts, skills and values, the teacher needs to present a variety of teaching and learning strategies that will cater for learners' diverse needs. In the case of Life Sciences teachers need to have competent knowledge of Life Sciences and be able to select and use teaching strategies that offer the appropriate level and type of support that will help the learner to become more competent.

Though there are many features of teaching that warrant examination and research, the main focus of this study was on how grade 11 teachers mediate biodiversity concepts in an English second language context.

My interest in this area of study as indicated above was influenced by the Examiners' Reports for Life Sciences from 2009 to 2012 which indicate that learners struggle consistently with mastering questions relating to terminology specifically focused on biodiversity (DoE, 2012). These reports further indicate that, too often, learners' answers consist of guess-work rather than diligence in working through possible options, resulting in candidates losing marks. Furthermore, the reports highlight that learners lack clear understanding of the questions and, as a result, provide irrelevant information in their exam scripts which cannot be awarded any marks (Chief Marker's Report, 2012).

It was also indicated in the Examiners' Reports that many learners struggled with incorrect spelling of terms. As an example, for 'altricial' development they wrote 'artificial', 'attricial', or 'attricocial' which consequently cost them marks. The reports reveal a disappointing performance by learners, with an average mark of 38% (DoE, 2009-2012). This indicates an ongoing and worrying trend in Life Sciences.

In light of this context where learners struggle to write correct spelling of biodiversity terms which alters meaning of such terms, I decided that it would be valuable to explore ways in which educators can help English second language learners make sense of biological concepts when teaching biodiversity. By developing a better understanding of these language issues in the teaching and learning of Life Sciences within the topic of biodiversity, I hope that student performance in this subject will improve.

1.3 Historical and contextual features of language issues in science teaching

1.3.1 Historical context

During the colonial period in South Africa the government legislated the use of Afrikaans and English as languages of instruction (Probyn, 2004). In the early 1960s, during the apartheid era, Afrikaans was the enforced official language of instruction. It was only after the protest of June 16, 1976 (also known as the Soweto uprisings) that English was also included as a medium of instruction and citizens had the opportunity to choose between Afrikaans and English as the medium of instruction (Christie, 1985).

In the post-apartheid era, 11 different languages are considered official languages in South Africa (DoE, 1997). In contrast, however, the language used in school textbooks as well as in assessment of learning is either English or Afrikaans. These two languages are used for both mother tongue language speakers as well as native speakers. *IsiXhosa* mother tongue speakers make up the majority of learners in schools in East London, where my investigation was based, and this is even truer of schools in the rural and township areas. In contrast, schools in the city centre are populated by a greater number of both English and Afrikaans speakers and fewer *isiXhosa* speakers. The official languages of instruction and assessment, as specified in my discussion above, are English and Afrikaans, even though learners and teachers in rural areas as well as township areas are second language speakers of these languages.

1.3.2 Contextual features of language issues in science teaching

Bright and Brock-Utne (2001) indicate that having a foreign language as a language of instruction is always a barrier to knowledge. In the context of this study, the teaching and learning of Life Sciences in a foreign language may result in conceptual, linguistic and psychological problems in the classroom. Among these problems are low achievement levels, which can in turn be linked to students' misconceptions and their academic failure. In line with this argument, Vygotsky (1978) claims that language is a tool which helps a child construct ways of thinking, and that concepts cannot be acquired in conscious form without language. Vygotsky also argues that a child cannot have conscious understanding of concepts before they are explained in a related context using language.

Language in the Life Sciences consists of scientific terminology and mathematical language which is used to explain concepts, ideas, principles, phenomena, mechanisms, theories, laws and models. Lemke (2001) argues that one of the major difficulties experienced by learners in the field of science is learning the language of science. Accommodating the needs of multilingual and second language learners is one of the biggest challenges facing today's teachers. Evidence of this has been noted in the Examiners' Reports (DoE, 2009-2012) which highlight that learners encountered problems mastering terminology questions. Echoing similar findings, Nakale (2012) argues that one of the challenges facing Namibian teachers and learners is the inability to use specialised conceptual language to make meaning of biological concepts. This results in learners resorting to rote memorization (Kocakulah, Ustunluoglu & Kocakulah, 2005) - that is, rather than acquiring a depth of understanding of the vocabulary, learners memorise scientific terminology temporarily for exam purposes and soon forget the meaning.

1.3.3 Risks associated with issues of language in Life Sciences

From an analysis of the Curriculum and Assessment Policy Statement (CAPS) documents, I identified the effect of teaching in foreign language as a risk associated with issues of language in Life Sciences. The issue of language was highlighted both by respondents and in the records of Examiners' reports from 2009-2012

Probyn (2009) describes foreign language as 'unnatural language' or 'language of another country'. In the context of this study, foreign language is English. The CAPS document indicates that teachers should be aware that in addition to teaching subject specific material, they are also engaged in teaching language across curriculum (CAPS 2011). This is especially true in a context where the language of learning and teaching is not the home language of the learners. Furthermore, teachers are required to provide learners with opportunities to develop and improve language skills in the learning context of Life Sciences. This is critical as learners are required to write reports, paragraphs and short essays as part of their assessment which constitutes approximately 20% of their marks during the final examination.

Additionally, Section A in examination papers consists of a variety of questions such as multiple choice questions, terminology, matching items, diagrams and so forth and all questions are compulsory. This section requires a thorough understanding of Life Sciences terminology across

the curriculum. Terminology has a specific place in Life Sciences as it seeks to explain not only concepts but also processes, phenomena, mechanisms, principles, theories, laws and so on. This is therefore the language that underpins the whole study of biology. There is progression of concept and content across the four knowledge strands in Life Sciences meaning that if a learner has failed to grasp the concepts consequentially in each phase of learning, they risk failing the subject entirely. Such a learner would be at a disadvantage studying the subject, accessing knowledge from resources, acquiring in-depth understanding by reading textbooks, participating in dialogue and debate, and responding in test situations.

In addition to the scientific language used in Life Sciences, mathematical language is also used to illustrate concepts, plan and carry out investigations for problem solving, and measure and quantify observation (Lemke, 1990). This type of language may be regarded by learners as foreign, especially in the case of those who study Life Sciences alongside non-academic subjects which do not require this sort of mathematical literacy. In light of this context English second language learners are faced with the challenge of conceptualizing scientific concepts in the language that is foreign to them which requires competency not only in scientific language but also mathematical literacy. Influenced by this context I developed a keen interest in investigating how educators mediate biodiversity concepts (irrespective of these barriers) in helping learners make meaning of biological concepts.

The Examiner's Report for 2009 highlighted that *"very few learners know the concept – continental drift and did not understand geological explanation"*. This is just one example of the type of terminology used in teaching evolution in Life Sciences, a topic dealt with when teaching biodiversity which is the focus of this study. From the above comment one can deduce that the inability of the learner to conceptualise the term 'continental drift' hindered his/her ability to make connections with 'geological explanation'. The report goes on to say, *"most learners were confused with this question. They used the terms variations, natural selection, and adaptation wrongly"*. The report ended by saying that, *"the question was poorly answered by learners. Learners must read a question and ask themselves what is being asked"*. If the learner was unable to understand the terminology used, how would more care in reading the question help at all? The issue might not necessarily have to do with the learner understanding the question posed in an exam, but rather with understanding the terminology used in the questions themselves.

Furthermore, the Examiner's Report (DoE, 2012) indicates that learners repeatedly reported that they encountered problems in mastering terminology questions. The report highlights that, "*The performance in terminology is greatly disappointing. The average mark obtained by 100 learners is 2.6 and the average is 38%*". To this end, Wellington and Osborne (2001) argue that one of the major difficulties experienced by learners in learning science is learning the language of science. They further suggest that paying attention to language is significant for improving the quality of science education which should, by implication, also be viewed as a language lesson. To do well learners should be able to extend their knowledge of concepts beyond basic vocabulary and be able to engage in discussions (Schaffer, 2007).

Kocakulah, et al. (2005) argue that students may become quite proficient in grammar, vocabulary and sentence structure but may lack necessary cognitive academic language proficiency to learn the subject in science courses. This is consistent with the argument in the Examiner's Report (DoE, 2012) which indicates that learners lack the interpretation and analytical skills that would enable them to answer higher order questions.

In a study conducted in Turkey by Kocakulah, et al. (2005) on the effect of teaching in native and foreign language on students' conceptual understanding of science, it was observed that students struggling to learn science in a second language lose at least 20% of their capacity to reason and understand in the process. They further note that psychological problems indicate that second language learners are frustrated by failure and tend towards rote learning which does not require much storage in memory and is subsequently easily forgotten (ibid). They further argue that a lack of knowledge of grammar, the rules of syntax, and the meaning of words in different contexts puts second language speakers at a disadvantage. These learners are less able to see meaning in texts (ibid).

This argument is consistent with the Examiner's Report (DoE, 2012) which states, "*It seems as if learners had trouble understanding the question and hence failed to follow instructions carefully. This had an adverse effect on their performance, this could be an indication of a language problem*". The report further highlights that learners were unable to read and understand what was required by the question and as a result gave irrelevant information which was not worth awarding marks (DoE, 2012).

In light of this context, Vygotsky's (1978) perspective on learning is that concepts cannot be comprehended without language. Vygotsky explains that the interaction between learning and development happens at the zone of proximal development (ZPD) and that this is central to the learning process. He further defines the ZPD as the distance between actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more a capable peer. ZPD depends on social interaction and involves face to face interaction mediated by speech in the classroom. He strongly believes that speech plays a critical role in children's learning in the ZPD and in the process of assistance and instruction.

The effect and significance of language on learning is clearly outlined in the discussion above. However, it is important to investigate possible ways of assisting learners in making meaning of Life Sciences concepts irrespective of language as a barrier. It is against this background that it became vital for this study to explore how Grade 11 educators mediate concepts in Life Sciences, in particular, in biodiversity.

In answering this question and to pursue the goals of this study I then observed practices of two grade 11 teachers at two different schools in East London, Eastern Cape.

1.4 Research objectives and goal

The main goal of this study was to understand how Grade 11 teachers mediate biodiversity concepts for English second language learners. To achieve this goal, I endeavored to answer the following questions:

1.4.1 Main research question:

How do Grade 11 Life Sciences teachers mediate biodiversity concepts for English second language learners?

1.4.2 Objectives and sub-questions:

1. To identify challenges experienced by English second language learners in making meaning of biological concepts in biodiversity. This was achieved by answering the

following sub-question: What are the grade 11 Life Science teachers' experiences and views on English second language learners' challenges in understanding biodiversity concepts?

2. To explore how grade 11 Life Sciences teachers scaffold English second language learners in making meaning of biodiversity concepts. This was answered by asking: What pedagogy and strategies do grade 11 Life Sciences teachers use in assisting second language English speaking learners to make meaning of biodiversity concepts?
3. To identify challenges experienced by grade 11 Life Sciences teachers when helping English second language learners to make meaning of biodiversity concepts. This was answered by asking the following question: What challenges (if any) do grade 11 Life Sciences teachers experience when assisting their learners to make meaning of biological concepts in biodiversity?

1.5 Methodology

1.5.1 Orientation and design

The study is underpinned by a qualitative design and it took the form of a case study. This study has been conducted within social research in which the researcher looks at the phenomenon in its real life context applying different types of data gathering techniques.

This study used interpretative, descriptive and naturalistic approaches (Baxter & Jack, 2008), which were relevant to the study of teaching in Grade 11 Life Sciences classrooms. Driven by the desire to get an in-depth understanding of the case at hand in its real context, the classroom, I examined the different levels of pedagogical support at a micro level, within moment-to-moment scaffolding and during interactions as they unfolded as in their natural settings.

1.5.2 Data generation techniques

The study consisted of three phases. The first phase was that of gathering information relating to the experiences and views of teachers of second language learners in making meaning of Life Sciences concepts, in particular, biodiversity concepts. This information was gathered through semi-structured interviews. The information gained through these interviews formed the

foundation for identifying how grade 11 Life Sciences teachers assist learners in making meaning of biodiversity concepts and assisted me in answering my sub-question 1 and part of sub-question 2.

In order to establish whether there was a match between what teachers said and their actual practice, I then observed the teaching practice in their classrooms. These observations constituted the second phase of my data gathering and helped me to identify the pedagogical strategies used by the two teachers in assisting their learners to make meaning of concepts in biodiversity, thus enabling me to answer my research sub-question 2. I was also able to identify some of the challenges experienced by teachers in assisting English second language learners which enabled me to partly answer sub-question 3.

I also analysed learners' workbooks in order to establish the effectiveness of the strategies as well as to identify the challenges that arose from their responses.

Findings on these observations were verified through stimulated recall interviews (Lyle, 2003) which provided more clarity on the intentionality of choosing a certain method over the other when assisting learners to make meaning of certain concepts. The responses from these interviews also outlined some of the challenges faced by teachers when assisting English second language learners. Stimulated recall interviews were conducted in my third phase of data gathering while watching the filmed lessons with the teachers.

The decision to use different data gathering techniques was influenced by the need to get more information and a better understanding of the issue under study and by validation of claims made at the end of the investigation (see Section 3.7).

1.6 Theoretical framework

The study draws on Vygotskian theory of mediation (Vygotsky, 1978). The Vygotskian perspective on teaching is that it is a social activity involving mediation action which is an interaction between individuals and mediating tools. Vygotsky uses the term Zone of Proximal Development (ZPD) as a metaphorical tool to explain the potential learning of children during problem solving activities with adults or peers. The concept of Scaffolding which was later

related to the Vygotskian theory of ZPD is used to justify instructional strategies in the classroom.

My study was guided by the social constructivist perspective of Vygotsky (1978) as this theory explores aspects of language usage. Social constructivists describe how knowledge is constructed by humans in a social context and recognises that learners construct knowledge and understanding through social interactions with others. In social constructivism, language is identified as one of the tools that enables understanding and acquisition of new knowledge. From the perspective of social constructivist theory, language is at the centre of developing ideas.

In understanding how and why teachers used certain pedagogical strategies when assisting learners to make meaning of Life Sciences concepts, Shulman's (1986) Pedagogical Content Knowledge (PCK) was blended with Social Constructivism in this study.

1.7 Potential value of my study

- Insights into the role and challenges of language in the teaching of science to English second language learners may be gained, thereby potentially opening up opportunities to improve student science performance.
- My study could enable participating Life Sciences teachers to reflect on their practice and provide success stories and areas to improve on, as well as possible remedies to areas of weakness in teaching (if any).
- The reflections might be shared among the wider group of East London Life Sciences teachers and may assist in improvement of our teaching practice.
- The findings from the study could be used by Life Sciences departmental officials to identify areas of support and develop possible intervention programmes for improved practices.
- The study could also serve as personal empowerment - as a teacher, I will be also learning in the process.

- Future researchers in the field of mediation of learning in Life Sciences might use the study as a source of valuable information.

1.8 Definition of concepts

The following concepts are often used in this study:

- **Strategies:** Ways of presenting instructional material (Walqui, 2006)
- **Scaffolding:** All types of support and guidance offered in the classroom (Walqui, 2006)
- **Mediation:** Complex interactions in a learning environment that afford opportunities for learning (Vygotsky, 1978)
- **Meaning making:** Ability of learners to make sense of/connect new concepts by relating it to their existing knowledge (Van Lier, 1996)
- **Second Language:** A language learned in addition to one's home language (*isiXhosa* in the study) (Probyn, 2004)

1.9 Overview of the thesis

This thesis comprises findings from two schools in East London and consists of six chapters outlined below.

Chapter 1

This chapter gives a brief introduction to the study. It provides a background to the study and an overview of the area in which the study took place. It outlines my role and interest, the goals and objectives of the study, and details the research questions. This chapter also provides insight into the potential significance of the study.

Chapter 2

Chapter 2 consists of the overview and discussion of literature relevant to my study. The discussion looks at the nature of Life Sciences, and the history and context of environmental

education with specific reference to biodiversity as part of the Life Sciences curriculum. The chapter also reviews South African curriculum expectations, looking at issues of language and scientific concepts in Life Sciences. This chapter also explores various research studies relating to language and science with specific reference to mediational means that teachers exploit when assisting learners to make meaning of Life Sciences concepts, in particular, biodiversity. This chapter also discusses relevant theoretical frameworks that underpin the study, namely, mediation of learning, social constructivism and pedagogical content knowledge (PCK).

Chapter 3

This chapter discusses the overall description and design of the study, focusing on the research design and the methods that I used to generate data. It provides details of how data was analysed and interpreted for validity and explores the trustworthiness of the findings. This chapter also discusses issues of ethics.

Chapter 4

This chapter presents data generated from the interviews, lesson observations and document analysis. This chapter also presents emerging themes and categories from the processed data.

Chapter 5

Chapter 5 provides an analysis and interpretation of data. Insights from the literature review give meaning to the interpretations of this data.

Chapter 6

This chapter presents some conclusions, recommendations of the study, the limitations and possible opportunities for further research.

In the next chapter I review literature relevant to my study.

Chapter 2: Literature Review

2.1 Introduction

The research sought to understand how Grade 11 Life Sciences teachers mediate biodiversity concepts with English second language learners. The literature review will focus on exploring a variety of ways of providing support for learning, looking at a range of mediational means and effective construction of Life Sciences content knowledge, in particular, biodiversity concepts, with learners in ways that promote and sustain student learning. Biodiversity is a topic in Life Sciences that is taught from grade 10-12 which takes more than 50% of the Life Sciences knowledge content that is supposed to be learnt in these grades. Biodiversity is a wide ranging concept which runs across two out of four knowledge strands in Life Sciences namely Diversity change and continuity, and Environmental Studies. The wide scope of content in these knowledge strands indicates the complexity of this concept. Influenced by this context it became of interest for me to investigate how teachers mediate this concept.

In situating the study in an appropriate theoretical framework, relevant learning theories in science learning with special emphasis on teacher and learner, learner and learner, and learner and activities interactions in meaning making in Life Sciences classrooms will be explored.

This chapter will start by looking at the nature of Life Sciences, and the history and context of environmental education with specific reference to biodiversity as part of the curriculum in Life Sciences. The study will then look at South African curriculum expectations, focusing on issues of language and scientific concepts in Life Sciences. The chapter will also explore previous research on language and science with specific reference to mediational means educators should explore to make meaning of Life Sciences concepts. The discussion will be concluded by focusing on relevant theoretical frameworks which underpin the study, namely, mediation of learning, social constructivism and pedagogical content knowledge (PCK).

2.2 Nature of Life Sciences

Life Sciences is one of the branches of science. The CAPS (2011:8) document explicitly describes Life Sciences as the scientific study of living things from molecular level to their interaction with one another and their environments. It uses certain methods for broadening existing knowledge which lend themselves to systematic approaches to inquiry. These involve several interconnected steps: observation, looking for regularities and patterns, making hypotheses, devising qualitative or mathematical models, deducing their consequences, verification or falsification of theories through observations and controlled experiments (DoE, 2011). These methods include formulation of hypotheses, carrying out investigations, and objective experiments to test these hypotheses. It is for this reason that science is regarded as the most powerful and reliable knowledge system relating to the nature of the physical world (Lemke, 1990).

Furthermore, Life Sciences is a subject that deals with the role of enquiry, investigation and data collection, and develops skills such as observation, recording of results, analysing and communicating these results using various forms of data presentation. Khalil (2012) presents the following as the principles which underpin the study of Biology (now known as Life Sciences):

- Cell theory: living things are composed of basic units of life and new cells are formed through cell division;
- Gene theory: living beings' traits are encoded in DNA and can be passed down through inheritance;
- Homeostasis theory: all living beings can maintain the functioning of their internal environment irrespective of the changes to the external environment;
- Energy principle: all living things require energy to function and survive (ability to use up and transform energy); and
- Biological Evolutionary theory: all the life forms that we see today descended from those of the past, but they may look different because they have changed over a period of time (descent by modification).

The content of the syllabus prior to 1994, which was known as the National Assembly Training and Education Department (NATED 550), was dominated by the first four principles outlined above. This curriculum listed the content to be covered within the learning program. The concept of environmental education in Life Sciences, previously known as biology, only emphasised the components of the ecosystem and interconnections between them which was studied under the topic ecology. Le Grange (2002) suggests that the inclusion of this topic was in response to the growing recognition of human exploitation of the earth's finite resources. The principle of biological evolution was later included in the new syllabus under the strand 'Biodiversity change and continuity,' which forms part of environmental education.

2.2.1 History and context of environmental education in the South African context

Irwin and Lotz-Sisitka (2004) argue that the Belgrade Charter and Tibilisi principles of 1977 had a positive influence on the emergence of environmental education in South Africa. The main focus prior to this was on conservation of natural resources and ecology.

The international conference on environmental education in Natal in 1992 resulted in the Development of the Environmental Education Association of Southern Africa (EESA) which coordinates policies and procedures in a call to develop curriculum policy in formal education. This resulted in the establishment of the Environmental Education Policy Initiative (EEPI), which subsequently became known as the Environmental Education Curriculum Initiative (EECI).

In 1994, a socio-economic policy framework was tabled by the African National Congress (RSA, 1994). The policy framework was aimed at addressing economic, social, political and environmental issues. The Reconstruction and Development Program commonly known as the RDP was the result. This programme was aimed at addressing and meeting the basic needs of the South African people. In the process of addressing such needs it became apparent that the conservation of natural resources in order to sustain human life should be prioritised. This priority was subsequently included in the South African constitution in the bill of rights (RSA, 1996:6) which states that:

Everyone has a right to an environment that is not harmful to their health or wellbeing; and to have the environment protected, for the benefit of present and future generations

through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Concerning the issue of education, the RDP proposed that the field of education be restructured. This required the training of teachers who would be committed to the goals of the RDP and who were also competent to achieve these goals. Such educators and trainers were expected to respond flexibly to the curriculum and understand the challenges of its delivery.

In 1995 a white paper was released which presented a frame work for the transformation of the education and training system (RSA, 1995). One of the principles stated that:

Environmental education involving an interdisciplinary, integrated and active approach to learning must be a vital element of all levels and programs of education and training systems in order to create environmentally literate and active citizens and to ensure that all South Africans present and future enjoy a decent quality of life through sustainable use of resources (p.18).

In 2005, Outcomes Based Education (OBE), Curriculum 2005 (C2005), and later the revised National Curriculum Statement (NCS) were developed in order to integrate environmental education in South African schools. Environmental education became a phase organiser in all learning areas compelling all teachers to engage with it (Irwin & Lotz-Sisitka, 2004). Chisholm (2005) indicates that the Environmental Education Curriculum Initiative (EECI) lobbied for the inclusion of environmental education in the curriculum by emphasising the significance of knowledge integration. According to Chisholm (2005), the EECI stressed the interrelatedness of environmental, developmental and education issues in their quest to improve the knowledge, skills and awareness of sustainable development in all learning areas.

C2005 was characterized by an emphasis on outcomes and integration. By placing greater emphasis on subject-related, content-based knowledge, C2005 was revised to NSC. The education minister then established a national project for environmental education in formal curriculum (Irwin & Lotz-Sisitka, 2004), which saw a project in support of teachers developing lesson plans for environmental learning being initiated. This project aimed at assisting learners in exploring the complexity of environmental issues in their own context.

In 2011 an amended version of NCS was developed which is currently known as Curriculum and Assessment Policy Statement (CAPS). This is a more content focused and structured policy than NCS, ensuring that teachers have a clearer understanding of what to teach, and how much scope one should cover in each topic given. The principle that caters for environmental education in CAPS, which is also reflected in NCS, is the infusion of principles and practices of social and environmental justice and human rights, which is in line with the South Africa Constitution (DoE, 2011).

The content framework in Life Sciences CAPS is organized according to four knowledge strands. These strands are developed progressively over the three years of the FET (Further Education and Training) Phase. Environmental education falls under Knowledge strand 3, which is Environmental Studies, and Knowledge strand 4, which is Diversity Change and Continuity. The focus of my study, biodiversity, runs across the two strands in all grades in the FET band (Grade 10, 11 & 12). In Grade 10 the focus is on biodiversity and classification as well as tracing the history of life on earth. In Grade 11 the focus is on biodiversity and classification of micro-organisms, plants and animals. These topics in Grade 11 are under strand 4 but synchronise with strand 3 on the topic: 'Human impact on the environment: current crises'. This topic is currently part of the grade 12 syllabus.

2.2.2 Policy features in Life Sciences

CAPS is the South African policy that currently guides the teaching of Life Sciences in Grades 10-12 as stated above. CAPS aims to provide guidance on the development of learner understanding of Life Sciences, in particular, knowledge of key biological concepts, processes, systems and theories, and the ability to critically evaluate and debate scientific issues. Learners are required to develop a level of academic and scientific literacy that enables them to read, talk about, write and think about biological processes, concepts and investigations (DoE, 2011). The content framework focuses on ideas and concepts as well as on connections between them but without any prescribed instructional strategies or methodologies. This gives room for teachers to expand concepts and to design and organise learning experiences according to their particular circumstances, including availability of resources.

It is recognised, however, that there is a gap in CAPS as it does not provide the teacher with the *how* part and places the onus on educators to implement methods of their choice. CAPS (2011:10), states that it does not prescribe particular instructional strategies but gives teachers autonomy to design learning according to their contextual needs. This poses a challenge to educators who are not familiar with a wide variety of teaching methods. Echoing similar sentiments, one of the findings in a study conducted by Songqwaru (2012), was that few teachers were able to give input on methods to be used when teaching environmental knowledge, while others had no knowledge of methods which could be used. Songqwaru relates this to teachers being unfamiliar with relevant or suitable methods to teach environmental knowledge.

Nonetheless, the subject specific aims in CAPS for Life Sciences are meant to guide the process of learning. These aims replace the Learning Outcomes in NCS. These are:

- **Specific Aim 1:** Knowing Life Sciences

This involves knowing, understanding and making meaning of biodiversity concepts which enable learners to acquire biodiversity knowledge, make connections between ideas and concepts, and apply biodiversity knowledge in new and unfamiliar contexts.

- **Specific Aim 2:** Investigating a phenomenon in Life Sciences

This involves planning and carrying out investigations relating to biodiversity, enabling learners to solve problems that require practical skills.

- **Specific Aim 3:** Appreciating and understanding history, importance and application of science of biodiversity in real life context. Understanding relationships between indigenous knowledge system and modern science of biodiversity.

This involves exposure to the relationship that exists between Life Sciences and indigenous knowledge (IK) which includes understanding of history and relevance to some scientific discoveries and their appreciation (DoE, 2011).

In order to assess competency or cognitive skills, Life Sciences teachers are required to use verbs such as state, name, label, list, define, describe, compare, predict, differentiate, illustrate, interpret or any other suitable verbs that indicate learners' cognitive academic language

proficiency and understanding of biodiversity concepts to enable learners to build meaningful conceptual frameworks (DoE,2011). The table below gives a summary of weighting of the cognitive demands for assessment of content in grades 10-12.

Table 1: Weighting of the cognitive demands for assessment of content in Grades 10-12

	Knowing science	Understanding Science	Applying scientific knowledge	Evaluating and analysing and synthesising scientific knowledge
%	40%	25%	20%	15%
	• State • Name • Label • List • Define • Describe and others	• Explain • Compare • Rearrange • Give examples of • Illustrate • Calculate • Make generalisation and others	• Predict • Apply • Use knowledge • Demonstrate • Solve • Implement • Judge	• Select • Differentiate • Analyse • Infer • Suggest a reason • Discuss • Categorise

The above table states that 60% of the assessment tasks require cognitive competency of learners, which refers not only to an understanding of biological concepts, but to the ability to analyse, apply and evaluate scientific knowledge. This requires proficiency in the language of instruction and poses a disadvantage to learners who lack academic language proficiency in learning subject matter in science courses. This is what triggered my interest in this field of research.

In addition to this, a specific science language is used in the form of Life Sciences terminology/vocabulary to explain certain concepts and phenomena, in particular, biodiversity. This is the form of language that enables learners to know, understand and make meaning of sciences and make connections between ideas and concepts as stated in the blueprint in Specific Aim 1 in the CAPS Document (DoE, 2011). Using this form of language, learners are expected to describe biodiversity concepts, processes, phenomena, mechanisms, principles, theories, laws

and models in Life Sciences. Through this, learners build a conceptual framework of the science of biodiversity which enables them to work with ideas, organize knowledge to derive new meaning, develop flow charts, diagrams and mind maps, and recognize patterns and trends which are used in assessing their cognitive skills as well as their competencies.

Mathematical language is another form of language used which enables learners to be more effective in planning and carrying out investigations and in solving problems that require some of the competencies as specified in Specific Aim 2 in the CAPS document (DoE, 2011). In observing results of experimental investigations which involve recording of information in an appropriate way, learners should know how to measure biodiversity and what to measure as a way of quantifying observations and making estimations. In assessing their competencies learners are required to convert information from one form to another, for example, converting a table into an appropriate graph. They are required to perform appropriate simple calculations in order to analyse and extract information from tables and graphs, apply knowledge to practical situations, recognise patterns and trends, and make deductions based on evidence.

2.3 The role of language during teaching and learning in Life Sciences classrooms

In educational activity much of the time is spent on talking and listening; be it between the teacher and learners or learners and other peer learners. Alexander (2004) argues that talking is one of the true foundations of learning as it is the basis of classroom interactions. Through talk, teachers constructively engage learners in the learning process. Alexander notes that the quality of classroom talk can be strongly linked to student learning. This involves mechanically practicing facts, ideas and routines, accumulation of knowledge and understanding through questions to test learners' previous knowledge and telling learners what to do. Alexander further argues that during the activity of acquiring knowledge many factors may affect the quality of learning. It is recognised, however, that the language medium of classroom learning and teaching language plays a significant role in knowing and coming to know.

Lemke (1990) argues that learning science means learning to talk science. Talking, according to his argument, means observing, describing, comparing, classifying, hypothesising, theorising, questioning, challenging, arguing and judging through language of science, and in this case,

biodiversity. This implies that second language learners are faced with a complexity of language demands while integrating language and science instructions.

Wellington and Osborne (2001) also posit that one of the major difficulties experienced by learners in learning science is learning the language of science. They further suggest that paying attention to language is very important in improving the quality of science learning. By implication, a science lesson should also be a language lesson. To do well learners should be able to extend their knowledge of concepts beyond basic vocabulary and be able to engage in and manipulate activities (Schaffer, 2007).

Kocakulah, Ustunluoglu and Kocakulah (2005) point out that a student might become quite proficient in grammar, vocabulary and sentence structure but may lack necessary cognitive academic language proficiency to learn the subjects in science courses. Cummins (1986) distinguishes between two kinds of language proficiency, namely, Basic Interpersonal Communication (BICS) and Cognitive Academic Language Proficiency (CALP), the latter being the kind of proficiency that enables the child to engage in dialogue, debate and response. It then becomes the role of the teacher to assist such learners to make meaning of science concepts irrespective of their language background.

Kocakulah, et al. (2005) state that students struggling to learn science in a second language lose at least 20% of their capacity to reason and understand in the process. They further note that learners exhibit psychological problems indicating that second language learners are frustrated by failure. In this context the learners tend toward rote learning which requires less memory storage, and leads to knowledge being easily forgotten. They add that a lack of knowledge of grammar, rules of syntax as well as meaning of words in different contexts puts second language speakers at a disadvantage, being less able to see meaning in texts as compared with their first language counterparts who have been exposed to inherent and informal methods of learning in their language at an early age. In socio-cultural research, Vygotsky (1978) suggests that language is a mediating tool which creates possibility of thought and organises the thinking process. Central to this process is language.

Probyn (2009) suggests that the use of English by second language speakers can be a barrier to learning limiting conceptual understanding (2009:128) and resulting in the generation of

misconceptions (Kocakulah, et al., 2005). Thus, Probyn (2004:59) emphasizes the importance of linguistic support to second language learners (Setati, 2002) in order for effective teaching and learning to take place in science classrooms.

As an example, Probyn (2009:128-133) draws our attention to a few positive aspects of teachers using code-switching in the classroom while teaching. She believes that code-switching is a legitimate language strategy which helps learners to better understand concepts. Firstly, she mentions that when using their mother tongue, learners can more easily understand certain concepts and it will assist in “reducing the alienation of the subject matter” so that learners can relate the subject at hand to their own experiences. In this way the teacher can reduce the “stress of learning through a second language” (Probyn, 2009:133) and at the same time cater for all learners in the classroom, whether fully bilingual or not.

It is recognised, however, that although code-switching in the classroom might help learners to understand certain concepts more readily, it can be extremely time-consuming to consistently translate learner home language into English, which is the medium of instruction in schools (Probyn, 2001; Olugubara, 2008). Furthermore, by consistently code-switching, the learners’ proficiency in English remains weak and learners find it difficult to express themselves in English. This may lead to poor examination results as no code-switching takes place here and learners might fail to interpret and answer questions correctly.

2.4 Pedagogical approaches

Rosenburg, O’ Donoghue and Olvitt (2008) describe an educational approach as a broad systematic and theoretical informed way in which educators approach educational interaction including educators’ intent - a collection of activities which coherently hang together to serve a particular educational purpose. Drawing on Vygotsky (1978) perspectives on mediation of learning, pedagogical approaches can be described as a structured process whereby a more experienced other uses tools to mediate or guide ways of knowing within a particular institutional context in such a way that knowledge and skills lead to relatively long-term learning.

Practice and research has revealed that there are instructional strategies that are effective for teaching sciences to learners with limited English proficiency (Vorster, 2008). Vorster notes that teachers do not necessarily have to be bilingual or monolingual to help students succeed but can use effective strategies to involve learners in a complex scientific world. Research shows that teachers can choose from among a number of approaches for teaching a given topic (ibid). However, the ability to choose may depend on the teachers' knowledge of content and suitable pedagogical approaches to deliver a particular content, as suggested by Shulman (2004).

2.4.1 What are the possible pedagogical approaches that Life Sciences educators could implement to make meaning of Life Sciences concepts?

The use of various teaching approaches is encouraged when teaching Life Sciences in order to accommodate learners with different learning styles and backgrounds, as well as to achieve a variety of educational purposes and outcomes. Pedagogical approaches also serve to provide a systematic and theoretically informed way of categorising and describing educational practices. Pedagogical approaches are ways in which educators can approach teaching and learning, some of which include information transfer, experiential, investigative and deliberative methodological orientations (O' Donoghue, Lotz-Sisitka, Asafo-Adjei, Kota & Hanisi, 2007).

Teachers, as experts on the topic, are expected to provide necessary background information in order to clarify concepts or introduce specific foci (information transfer). Teachers are also encouraged to expose learners to local sites which show evidence of biodiversity thus allowing learners to gain firsthand experience of the subject. Experiential learning, that is gaining knowledge about what we can see, touch and feel, leads to improved learning (O' Donoghue, et al., 2007).

It is for these reasons that various participatory learning activities are encouraged to involve learners in the education process. Furthermore, field work and research methodologies are recommended to complement information that is already available. These are valued as a form of active and experiential learning developing practical enquiry skills as well as conceptual understanding and broader insight.

2.4.2 Using practical work or investigations to make meaning

Practical work has always been considered part and parcel of teaching and learning in Life Sciences. O' Donoghue, et al. (2007) argues that hands-on involvement with subject material creates the ideal context in which to expand and develop language skills of learners as they talk about the substance of their learning. This implies that an inquiry-based teaching approach for practical work can facilitate the learning of Life Sciences while at the same time providing for language acquisition. In this context, practical work can be used as a link between learners' experiences, communication and learners' perception of the subject matter.

Lemke (1990) suggests talking science means observing, describing, comparing, classifying, hypothesizing, questioning, challenging, and arguing through the language of science. To perform these processes, learners must understand scientific concepts involved, know the related vocabulary and use the required language. Lemke further suggests that discussions, dialogue and argumentation as part of science teaching are propagated based on the evidence that spoken and written discourse is fundamental in the process of science learning.

Lending support to Lemke's points, Schaffer (2007) argues that learning is simplified if it moves from concrete to abstract; subsequently abstract concepts must be built on concrete foundations which are accurate. Scientific investigations can provide such foundations through the learners observing tangible objects, and then progressing to other process skills such as classifying, hypothesising and interpreting data. These skills are obtained by doing practical work and through observation, concept formation can be developed. This implies that involving learners in enquiry based activities can provide a powerful learning experience where they not only learn scientific content but also gain research skills and understand the nature of scientific problem solving.

Schaffer (2007) further posits that this would imply going beyond the textbook and using the classroom situation to its full advantage by including interactions between learners, demonstrations, hands-on activities and group work in the learning process. This would give learners an opportunity to work cooperatively and contribute to the development of social skills and language acquisition.

Collaborative group work was found to provide structured opportunities for developing English proficiency in the context of authentic communication about science knowledge (Vorster, 2008). Learning in a group invites engagement in dialogue as well as reflection to give meaning to a particular knowledge. At its best cooperative learning is strongly related to motivational issues, accountability for individual as well as team success, and a deeper understanding of mutual support and trust.

Schaffer (2007) points out that practical work is a learning experience in which learners interact with materials or secondary sources of data to observe and understand the nature of the world allowing them to make sense of their experience. Vorster (2008) argues that hands-on activities relating to natural phenomena are more accessible to learners with limited science experience than de-contextualised textbook knowledge. He further argues that hands-on activities are less dependent on formal mastery of the language of instruction and thus reduce the linguistic burden on second language learners.

The kind of approach discussed above illustrates the nature of science. For learners to have a better understanding they should do science as scientists do. Laplante (1997) argues that when learners work in small groups exchanging information and discussing ideas they reflect the collaborative nature of the scientific enterprise. In this case learners could, for example, explore the process of natural selection as a source of biological evolution and share their findings with their classmates. This approach can help learners discover how scientific knowledge is produced and in the process develop their rational thinking skills as well as their decision making abilities, while preserving their sense of excitement and curiosity (Laplante, 1997). From a language perspective, an enquiry-based approach could provide rich language involvement favourable in particular to English second language speakers who are the focus of this study.

2.4.3 Using case studies

Case studies are used to allow learners to analyse a particular issue in order to develop an in-depth understanding of that case (O' Donoghue, et al., 2007). In line with this Ruggiero (2002) states that case studies can be used to actively engage learners in learning about complex issues which affect their decision making. Learners can use relevant ideas and explanations to analyse the case looking at causes and possible intervention programs. For example, in investigating

biodiversity loss, learners could use case studies to examine human impact on the environment by investigating and analysing local issues such as over exploitation of natural resources and by exploring ways in which this impact can be minimized. Such case studies provide connections between prior knowledge and new knowledge forming a basis for the presentation of completely new knowledge enabling learners to reflect on these issues and to possibly take action. Constructivist theories of learning assume that learners come to learning situations with existing ideas and understandings which they use to make meaning of new knowledge. They suggest that learners actively build on their preexisting ideas and understanding.

O' Donoghue, et al. (2007) argue that these case studies can be used to encourage further dialogue among learners allowing them to deliberate on these issues and enabling them to express their own views and values and then come to a new, improved and perhaps jointly held understanding of matters. This method also involves the rigorous and respectful consideration of multiple perspectives based on careful reasoning (ibid).

2.4.4 Using analogies

An analogy entails a comparison of two domains of knowledge - one that is familiar and one that is not - with the aim of creating ways to enable learners to visualise abstract concepts (Venville & Treagust, 1997). However, teachers need to be wary of confusing analogies as they interfere with learning. In such cases learners may use analogies mechanically rather than grasping the information the analogy is meant to convey. This implies that learners may not be able to distinguish between an analogy and reality.

According to Venville and Treagust (1996), analogies can be used in the process of identifying similarities between two objects or processes for the purpose of explanation which will allow learners to visualise the abstract concept by providing concrete reference. Lemke (1990) argues that learners become more involved in the topic and pay more attention to the familiar language of an analogy rather than to the unfamiliar scientific concepts. Orgill and Bodner (2004) argue that analogies contribute to the increased confidence of learners in problem solving situations, especially when the problem is related by analogy to something they have already successfully solved. Orgil and Bodner further claim that using analogies can promote conceptual change by helping learners overcome existing misconceptions. As learners identify the shortcomings of

misconceptions they initially hold, analogies lead them to reject these misconceptions and adopt the accepted scientific concept under discussion, thus clarifying their thinking.

2.4.5 Using code-switching

Code-switching involves going from one language to another in mid-speech when both speakers know the same language (Cook, 1991). Learners are therefore taught bilingually as their home language and English are both used to facilitate the learning of Life Sciences. Code-switching is the most researched strategy used by teachers in classes where Life Sciences is taught in a second language (Webb & Webb, 2008). Life Sciences teachers in such contexts mostly use code-switching when presenting instructional materials regardless of teaching method or approach.

The benefits of and reasons for using code-switching as revealed in findings of various studies indicate that:

- Code-switching is viewed as a communicative resource that enables teachers and students to accomplish a wide range of social and educational objectives;
- The strategy provides learners with explanations in their home language to facilitate spontaneous and reactive discussions of concepts by learners and teachers;
- Learners' ability to think more analytically about things is improved as they can draw from experiences, meaning and modes of thinking (Barker, 2002). He further states that code switching is about bilingualism providing learners with an advantage of having a more varied range of experience than monolinguals;
- It is a teaching strategy that enables scaffolding in a much easier way (Vorster, 2008); and
- Code-switching enables students to solve practical problems, communicate effectively and think in a more scientific way (Olugbara, 2008).

Rollick and Rutherford (1996) found the use of learners' first language to be a powerful way to help learners to explore ideas and found that without code-switching some learners may develop alternative incorrect conceptions that could remain untested. He further outlines that learners'

work may conceal misconceptions that are more likely to be revealed in group discussions in the learners' first language. It is important that learners are afforded opportunities to interact with one another while exploring ideas and concepts in a comfortable environment where their first language can be used. This provides the support necessary for concept development whilst learners develop their proficiency in English, the medium of instruction in South African schools. At the same time, however, it is crucial that learners practice any newly acquired terminology and be able to talk about these concepts in English.

This is where the dilemma of code-switching arises. Probyn (2001) is of the opinion that the language of the classroom is often not English but a mixture of English and the mother tongue. Because the classroom is in many cases the only place where learners are exposed to English, teachers are under pressure to use English as much as possible, leaving little time for the use of the learners' mother tongue.

2.5 Relevance of pedagogical approaches

Teachers use a wide variety of approaches in their teaching practice but classroom contexts differ in the kinds of learning practices that are appropriate for each learning area or topic. Students learn more when they understand what they are learning, why they are learning it and how they will use their new learning. Effective approaches stimulate learners to search for relevant information, challenge them to use or apply new discoveries in new contexts, create opportunities to involve learners in decisions relating to their own learning, and enable learners to take ownership of their learning.

According to the CAPS document (2011), science education should help develop students' problem solving skills not only in the science classroom, but in their everyday lives. Thus, CAPS (2011) calls for pedagogical approaches that are inquiry driven with an integrated approach to teaching science with technology, language, mathematics practices relevant to students' lives. While there is no formula that will guarantee learning for every student in every context there is well-documented evidence about the kinds of teaching approaches that have a positive impact on student learning (O' Donoghue, et al., 2007).

The National Council of Educational Research and Training (2006) argues that relevant science approaches should be true to the child, true to life and true to science leading to the following criteria:

- Cognitive relevance - content process language and practices of curriculum are age appropriate and within cognitive reach of the child;
- Content relevancy - must convey significant and correct scientific content meaningful to the cognitive level of the learner;
- Process relevance - engage the learner in acquiring methods and processes that lead to generation and validation of scientific knowledge and nurture the natural curiosity and creativity of the child in science;
- Historical relevance - science curriculum be informed by historical perspective enabling the learner to appreciate how scientific concepts evolve with time; and
- Environmental relevance - science must be placed in the wider context of the learners environment, local and global, enabling him to appreciate the issues at the interface of science technology and society. Linking learners learning to their everyday knowledge is widely advocated in science research policy to provide learners with science that they can widely use building on their experiences and knowledge (DoE, 1995).

Kalumba (2012) notes that for teaching and learning approaches to be relevant they should foster supportive learning environments, encourage reflective thought and action, enhance relevance of new learning, make connections to prior learning and experience, and provide opportunities to learn. According to Kalumba (2012), learning is inseparable from its social and cultural context and the role of the teacher in shaping the learning experience is vital. He argues that there is a direct relationship between teaching methods and quality education. His argument is based on teaching methods as mediating tools and notes that the type of teaching method employed to mediate concepts influences learning. This resonates with Vygotsky's perception of teaching methods as mediational tools, as he argues that for learning to take place there should be effective means of transmitting knowledge. Within this framework, teacher-learner interactions are vital.

2.6 Theoretical Frameworks

This study draws on a Vygotskian theory of mediation (Vygotsky, 1978). Vygotsky perceives teaching as a social activity that involves mediation action which is an interaction between individuals and mediating tools. The concept of mediation helped me to understand how Grade 11 educators mediate biodiversity concepts with English second language learners. In understanding how and why teachers used certain pedagogical strategies over the other to make meaning of biodiversity concepts, Shulman's (1986) Pedagogical Content Knowledge (PCK) was reviewed to help me in this regard.

2.6.1 Mediation of learning

Mediation of learning is the main focus of the Vygotskian theory of learning. In simple terms mediation refers to the use of tools to accomplish a certain action, for example, in order for a farmer to till the soil, he needs a spade. The spade mediates the task between the farmer and the soil enabling the farmer to accomplish the desired task (planting). Mediation of learning requires complex interactions between school systems and the environment, and the learning opportunity which teachers provide for children should allow for complex interaction (Walqui, 2006). The Vygotskian perspective is that teaching is a social activity involving mediation action which is an interaction between the individual and the mediating tools. Vygotsky asserts that the child learns to use tools of various kinds, many of which are culturally and historically based.

Language as a cultural tool is regarded as the most powerful and pervasive tool humans possess to mediate their connection to the world, to each other and to themselves. It is a tool that creates possibility for thought and organises the thinking process (Vygotsky, 1978). Lemke (2001) asserts that science education requires learners to talk and write the language of science in order to meaningfully and cooperatively engage with a range of sub-cultural activities like observing and experimenting. Because of this context, it seemed worthwhile to investigate within this study how educators make meaning of biodiversity concepts when teaching English second language learners. My focus within these observations was on the learner engagement with the tasks given and dialogue between teacher and learners.

Vygotsky uses the concept of mediation to explain the process that enables human consciousness development through interaction of tools. He claims that the interactions allow opportunities for

mediated actions that contribute to social formation of their consciousness. According to Vygotsky, teachers have a role in shaping their students' learning. Thus, teachers are viewed as cognitive guides in the learning process. This is crucial in determining the manner in which teachers teach and respond to students' learning. Walqui (2006) argues that the process of learning involves interaction, especially engagement with other learners and teachers, in joint activities that focus on matters of shared interest which contain learning opportunities. It is for this reason that I used mediation of learning as the theoretical framework for this project with the unit of analysis being meaning making in biodiversity concepts.

Vygotsky uses the term Zone of Proximal Development (ZPD) as a metaphorical tool to explain the potential learning of children in problem solving activities with adults or peers. The concept of ZPD is used to justify instructional strategies in the classroom. Related to the concept of ZPD is the concept of scaffolding as suggested by Bruner (1993). The concept of scaffolding is also used to justify pedagogical strategies in the classroom.

2.6.1.1 Vygotsky's theory of learning and ZPD

A wide range of literature on child development and education describe Vygotsky's theory (Meadows, 1993; Light, Sheldon & Woodhead, 1995; Lee, 1999). Vygotsky asserts that a child develops cognition and language as a result of social interaction with more knowledgeable others. In line with this, Walqui (2006) argues that education is deeply embedded in the socio-cultural setting and that it provides opportunities for participation and interactive give and take with more knowledgeable individuals in solving everyday problems. Externally socially mediated dialogue becomes gradually internalised and becomes the child's personalised resource for their own thinking. This theory asserts that the knowledgeable other has all the language and cognition necessary to perform tasks. His/her role is to guide the child by relevant behaviour with the intention of allowing the child to ultimately perform the task confidently and successfully on his/her own. This can be accomplished through modeling behavior and language to familiarise the child with the process and procedures involved.

The knowledgeable other/skilled person is there to help where the child gets stuck. Van Lier (1996) argues that for the child to carry out the task in a meaningful way, the adult links the task with previous knowledge and experience. The adult and child jointly work together focusing on

the activity and its goals drawing each other in a common direction. Van Lier (1996) argues that this constitutes the area of self-regulated action. Vygotsky termed this as ‘Zone of Proximal Development’ (ZPD). The ZPD is defined as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under the guidance or in collaboration with more capable peers” (Vygotsky, 1978:76).

Walqui (2006) summarises the main principles in Vygotsky’s learning theory as follows:

- Social interaction is the basis of learning and development;
- Language is the main vehicle of thought;
- Mediation is central to learning;
- Learning precedes development; and
- The ZPD is the primary activity space in which learning occurs.

2.6.1.2 Scaffolding

The idea of scaffolding originates from the work of Bruner who defines scaffolding as follows:

...a process of setting up the situation to make the child’s entry easy and successful and then gradually pullback and handing the role to the child as he [sic] becomes skilled enough to manage it (1993: 60).

Scaffolding, in the arena of building, is a temporary structure used in construction of buildings for protection and support which is then dismantled immediately upon completion of the building. Scaffolding, as a metaphor in teaching and learning, involves the interactive support that an adult offers to the child which ultimately enables the child to carry out the task without support. Bruner argues that scaffolding involves a gradual pulling back of assistance by the adult and a handing over of the role to the child as he/she becomes competent enough to manage the task on his/her own. It promotes the idea that learners take responsibility for their own work. As learners take charge of their learning the upper levels of scaffolding are changed, transformed, restructured, or dismantled.

The idea of scaffolding is closely related to Vygotsky's concept of the ZPD. In fact, Walqui argues that "it is within ZPD that scaffolding can occur" (2006:163). Wood (1988) argues that scaffolding is "contingent collaborative and interactive" (1998:96). Walqui further asserts that scaffolding becomes collaborative when the activity is jointly achieved and that it becomes interactive when the activity mutually engages two or more people.

The teacher should thus aim at developing a certain level of understanding. There should also be evidence that the learner can carry out the task successfully without the help of the teacher as well as evidence that the child has achieved some level of competence and independent functioning. Vygotsky refers to this as self-regulation.

In summary, scaffolding can be referred to as a particular kind of help and support that enables a child to accomplish a task that they would not have been able to achieve on their own thus establishing a form of competence that will enable a child to accomplish similar tasks independently in future.

Van Lier (2004) highlights the following as features of pedagogical scaffolding:

- Continuity - This involves repetition of tasks that have connections with each other;
- Contextual support - The environment in which the task is done should be supportive of the task or enable learners to use the environment to relate to what should be done;
- Intersubjectivity - Equal power sharing by establishing a good rapport in the process which shows mutual engagement in exploration of task;
- Contingency - Tasks may be readjusted or reconstructed depending on learner contributions and participation in the prescribed task;
- Handover/Takeover - By now learner confidence has increased in accomplishing the task. The educator then will gradually remove support thus allowing the learner to take charge of his own learning; and
- Flow - There is a balance between the learner's ability to do a task on their own and challenges being jointly tackled by both learner and educator.

The concept of scaffolding as presented thus far has been limited to interactions between the adult and the child. Donato (1994), however, expanded scaffolding to include not only the more knowledgeable other but also a relationship of equal knowledge between a group of students working together to accomplish a task that none of them would have been able to on their own. Learners in such cases create zones of proximal development for each other. Moll (1990) and Donato (1994) refer to this as collective scaffolding.

In both cases the learner has opportunities to learn either with the assistance of an expert or in collaboration with others. Lave and Wenger (1991) suggest that when assisted by the expert a learner experiences models of successful learning that enable him/her to participate in more complex activities. Additionally collaborating with others affords joint construction and discovery.

2.6.2 Social constructivism

Social Constructivist theories of learning recognise humans as social beings who come together in activities (Vygotsky, 1978). Vygotsky views learning as a social activity which is a human social construction. For social constructivists, learning does not only involve meaning making in the mind of the child but also involves other social aspects like language, interactions with educators, and interactions with other learners. According to this argument meaning making is a dialogic process which involves persons in conversation. From this perspective knowledge and understandings, including scientific understandings, are constructed when individuals engage socially in talk activity about shared problems or tasks

From the constructivist point of view learning is not directly transmitted from one knower to another but is actively built up by the learner. Learners are viewed as active participants in learning who come to the learning situations with existing understandings. Learning takes place at a construction site consisting of existing structures standing on a foundation. Learning is therefore an active process of constructing knowledge rather than receiving it. Supporting this idea, Schunk (2009) recognises that knowledge is not a commodity to be transmitted but a personal experience to be constructed. The implications for teaching are that teachers start by finding out what learners already know and engage them in meaningful activities. Teachers need to take this into consideration when planning their lessons.

In the constructivist paradigm, learning is learner centered with teachers acting as cognitive guides of the learners' learning. Teaching requires mediation where the teacher works at the interface between curriculum and student to bring the two together in way that is meaningful to the learner. Educators adopt a facilitative role which helps learners to arrive at their own understanding of the content. At a national level, efforts to bring in localised knowledge are evident in national policies and curricula that make specific reference to indigenous knowledge. The South African curriculum aims to ensure that children acquire and apply knowledge and skills in ways that are meaningful to their own lives promoting knowledge in local context while being sensitive to global imperatives (DoE, 2011).

CAPS is based on the principle of learning approaches that encourage active and critical thinking rather than rote uncritical learning. This is in line with constructivist perspectives of learning which state that learning occurs when individuals are actively involved in the learning process, integrating new knowledge with existing knowledge.

CAPS is also based on the principles that value indigenous knowledge, nurturing the values outlined in the constitution. At the school level teachers have to reinterpret the policy effectively to align with formal curriculum. They bring advanced levels of subject knowledge and pedagogical expertise to teaching and translate the broad statements into meaningful learning activities.

The challenge around use of localised knowledge according to Taylor (1999) is the educator's competence in the selection of relevant local knowledge that can be integrated into the school curriculum. Taylor claims that not all types of everyday knowledge provide suitable entry points to subject knowledge. Taylor is wary of an overemphasis on everyday knowledge at the expense of mastery of specific subject requirements. This means foregrounding everyday knowledge at the expense of conceptual knowledge.

Taylor's arguments are based on the misconceptions that anything and everything counts equally as knowledge. In such cases Taylor foresees a danger in using inappropriate everyday metaphors to illustrate concepts that do not have similar logical principles as those used in formal subjects. He warns that the use of such inappropriate metaphors can inhibit conceptual understanding rather than facilitate it. In addition, teachers may use real world analogies which obscure

understanding of logical relations rather than reinforcing relations. He also notes that there is an assumption that all school learning can be derived from direct application in the everyday world.

In support of this argument Mayer (2004) argues that not all teaching techniques based on constructivism are efficient or effective for all learners. He notes that educators misapply constructivism when using teaching techniques that require learners to be behaviourally active instead of being cognitively active. He argues that this equates participation with active teaching. Mayer proposes that learners should be cognitively active during learning, that is, learners must be able to make sense of what they are learning when everyday knowledge is used. According to Taylor, educators should use everyday knowledge judiciously rather than regarding it as the major focus of learning. They should do this by keeping the main purpose of learning in view all times.

2.6.3 Pedagogical Content Knowledge

Shulman (2004) claims that teaching is a complex work. One of the elements that shape the teaching practice is the choice of pedagogical approach the teacher employs to enhance learning. Such pedagogical reasoning is important because it is thinking which is central to creating a path through complex teaching and learning situations (Loughran, Berry & Mulhall, 2012). Loughran, et al. (2012) posit that pedagogical reasoning is a window into a thoughtful and skillful act of practice that is responsive to a given context crucial to shaping the manner in which teachers teach and respond to their students' learning.

The leading theories on mediation of learning and construction of knowledge presented in the above discussion show a strong relationship between learning theories and instructional practices. One of the critical factors that impact the teaching and learning process is how to design effective instructions that can address diverse learning styles and academic backgrounds (Loughran, et al., 2012). Shulman (2004) also asserts that effective learning occurs as a result of effective teaching strategies as well as teacher knowledge of the subject matter. Underlying all of this is the importance of the teacher's critical understanding of learning theories and how to apply them to the learning process associated with academic success of learners.

Any productive teaching strategies are governed by learning theories, a distinct area in curriculum development and educational practice. In order to develop effective lesson plans

educators need to possess a variety of skills and have understanding of different concepts, ideas and theories that inform their practice. It is against this background that my study is further informed by Pedagogical Content Knowledge (PCK), which was significant in answering my research question - understanding how Grade 11 teachers mediate biodiversity concepts in teaching English second language learners. The answer to the ‘how’ part in this question also depends on educators’ reasons for selecting a particular pedagogy. This selection process is influenced by teachers’ experience, their subject knowledge, and knowledge of teaching styles as suggested by PCK.

PCK is rooted in the belief that teaching is a complex process that requires more than just transmission of knowledge. It requires understanding of suitable methods of delivering information in such a way that brings meaning to the learners. It is a combination of content knowledge and knowledge of pedagogy. The choice of pedagogy becomes a reasoned one, meaning that educators have purposeful intent in choosing one teaching style over another.

This knowledge of practice is normally accumulated over time from experience of teaching or from research. The participants in my study have marked experience in teaching Life Sciences. My engagement with these participants enabled me to acknowledge that use of a particular strategy at a particular time was related to their accumulated experience. According to Shulman (2004), through experience a reflective teacher comes to recognise which method creates meaningful opportunities for learners’ understanding of a particular concept. In this way teachers do not “just pull out something different from a bag of teaching tricks” (Loughran, et al., 2012:4) but choose a particular method that is responsive to a given context. This pedagogical knowledge enables the educator to adapt and adjust learning procedures in ways that respond to student learning.

2.7 Concluding remarks

This chapter explored ways of providing support to learning focusing on various tools of mediation and effective construction of Life Sciences content knowledge in promoting and sustaining knowledge. Discussions in this chapter provided the contextual and theoretical framework relating to the South African context of education. Insights generated from the literature enabled me to make sense of the data collected which will be discussed in Chapter 5.

In the next chapter I discuss the research methodology.

Chapter 3: Research methodology

3.1 Introduction

This chapter provides a discussion of how the research question and topic was explored. It focuses on the research design and methods used to generate data, as well as details of analysis and interpretation of data for validity and trustworthiness purposes. The main goal of this study was to investigate how Grade 11 Life Sciences teachers mediate biodiversity concepts in teaching English second language learners. To achieve this goal, use of several levels of pedagogical support by Grade 11 educators in helping learners make meaning of curriculum were examined.

The study is premised on the assumption that it is possible for English second language Life Sciences learners to develop deep understanding of disciplinary knowledge and engage in challenging academic activities if teachers know how to support them in the process (Walqui, 2006).

3.2 Research Approach

3.2.1 Qualitative study

The study adopts a qualitative design which takes the form of a case study. It is a social research study in which the researcher looks at the phenomenon in its real life context applying different types of data gathering techniques. The researcher aims to understand meaning of human action and relies mainly on text-based data rather than numerical data. The study draws on social constructivist theory which is built upon the premise of a social construction of reality. The study also draws on a large body of research on effective practices with second language learners weaving together various levels of pedagogical support in promoting conceptual development.

This study has features of interpretative, descriptive and naturalistic approach (Leedy & Ormrod, 2010) which were relevant to this study based in the real world of teaching in Grade 11 Life Sciences classrooms. The research examined different levels of pedagogical support both at the micro level, and at the level of moment to moment scaffolding and interactions as they unfold in

their natural settings. My aim was to get an in depth understanding of the case under study in its real context.

This study looks at real people in real situations thus enabling the researcher to gain clarity of the educational context in close proximity, while at the same time providing a thick description of what is happening in life science classrooms. The researcher then places the study in the context of naturalistic and descriptive qualitative enquiry (Patton, 2002). The study becomes descriptive in the sense that it takes the form of words rather than numbers containing quotations from informants, field notes, transcripts from interviews and lesson observations.

In the context of the natural approach the researcher aims to understand the phenomenon under study in its real life context, in my case in Life Sciences classroom. This approach studies the nature of certain situations, settings, processes, relationships, systems or people that enable the researcher to gain new insights into the phenomenon under study (Frey, Botan & Kreps, 1999). Acts, words and gestures are regarded as significant as they provide the researcher with clues as to how and under what circumstances the behaviour came into being, thus enriching the data. Nothing is taken for granted or overlooked.

In this study data is generated, analysed and interpreted to enable the researcher to gain a better understanding of the phenomenon under study by adopting features of the interpretative approach. The interpretive approach attempts to make meaning of the phenomenon under study based on an ontology in which reality is constructed and interpreted by humans according to their beliefs and value systems (Orlikowski & Baroud, 1991).

The qualitative approach was advantageous in that it allowed exploration and utilisation of different instruments to collect data, such as face to face interviews, document analysis and observations.

3.2.2 Case study approach

Qualitative case study approach is an approach to research that speeds up exploration of the phenomenon under study within its context using a variety of data collecting instruments. Case study favours the collection of data in natural settings. The use of different data collecting instruments enables the researcher to explore the issue under investigation from different lenses

allowing glimpses into multiple facets of the phenomenon (Baxter & Jack, 2008) which is also useful as a validation technique.

The choice of a case study approach was guided by my research question which sought to understand how Grade 11 teachers mediate conceptual development when teaching second language classes. This is in line with Yin's view (2003) on selection of a case study, who notes that a case study should be considered when the focus of the study is to answer 'how' and 'why' questions. Examining the context and other complex conditions related to the study are integral to understanding of the case. The 'how' and 'why' part could not be considered without context - the Grade 11 second language classes - and it was in these settings that the researcher got a true picture of how and why teachers weave various pedagogical strategies together to support second language learners in conceptual development.

Yin (2003) suggests that a case study is used when one wants to investigate contextual conditions, that is, the real life context in which something occurs. This case study is explanatory in form since the researcher describes how and why the Grade 11 teachers use certain interventions in assisting second language learners in conceptual development. Exploration of this case using this viewpoint is guided by PCK as discussed in Section 2.6.3, which looks at how successful teachers combine use of pedagogy and knowledge in order to build a rich conceptual understanding for students.

In this study the classrooms of grade 11 Life Sciences teachers from two different schools with a record of good matric results were the site of data collection. The focus was on the teachers' experiences and views of teaching second language learners and on how the use of certain teaching strategies impact on the teaching and learning. The study centred on classroom interactions as they unfolded. These interactions were videotaped enabling the researcher to formulate questions for stimulated recall interviews. The data collection methods used were interviews, document analysis and observations, which will be discussed in Section 3.5 below. Use of various techniques in gathering data assisted me in triangulation which is a recognised validation technique.

3.3 Research site and sample

The study was conducted at two previously disadvantaged schools in the East London District in the Eastern Cape as indicated above. The district consists of more than 40 schools which are grouped into 15 clusters. The schools under investigation are coded as School 1 and School 2 and are both grouped in cluster 5. School 1 is a senior secondary school including grades 10 -12 which is located approximately 4km from my work place. The site is semi-urban, that is, it is situated between the urban and township area and is a newly developed area which used to be dominated by squatter camps. The school has predominantly Xhosa speaking learners and teachers and it offers Life Sciences as one of its subjects from grade 10 -12. The combination of subjects in the school is such that learners who take Life Sciences also take Physical science, Agricultural sciences and Mathematics as part of the curriculum. This means Life Sciences is only offered in the natural sciences streams while students from commercial and social science streams do not take Life Sciences as a subject.

School 2 is about 10km from my work place. The school is a senior secondary school which runs from Grade 8 -12 and is situated in a rural area. As with School 1, most of the learners and teachers in this school also come from a Xhosa speaking background. It must be noted, however, that the language of teaching and learning (LoLT) in both schools is English. Life Sciences in school 2 features in all the streams. This means learners doing commerce, natural sciences as well as social sciences take Life Sciences as a subject. Even though my study is not a comparative study it seemed that gathering data from contrasting environments could provide varied insights.

The sampling of schools was purposeful and convenient. Both schools had a record of maintaining good quality results in Life Sciences in the district. Both schools are located within the same cluster group as the school where I teach for easy accessibility. Both schools are within a reasonable distance from my work which made it possible for me to travel between my school and the site of my research without compromising much of my work as a full time teacher within the district. Cohen, Manion and Morrison (2007) suggest that a sample becomes convenient if the researcher chooses a sample that they have easy access to. Bryman (2001) views a sample that is accessible to the researcher as simply available. Bless and Higson-Smith (2005) view purposeful sampling as a disadvantage in that it depends heavily on subjective considerations of the researcher than on scientific criteria.

Both teachers were willing to share their experiences as well as their success stories of using certain strategies over the years. Both teachers have extensive experience in teaching and marking of external examination and are aware of the challenges that that second language learners face when answering questions in Life Sciences. Kumar (2005) suggests that the researcher is allowed to use her judgment in selecting informants that are deemed information rich. The extensive experience that these educators have in teaching the subject, and the quality of results in the subject that they have managed to produce over the years guided my selection regarding the choice of educators used in this study.

3.4 Research techniques

The following research techniques were used to gather data in this investigation:

- Document analysis;
- Key informant interviews; and
- Observation.

The choice of various techniques was influenced by the need to gain more insight and better understanding of the issues under investigation, as well as the validation of claims made at the end of the investigation. Each of these data generation techniques is discussed in detail below.

3.4.1 Document Analysis

Document analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning to the assessment topic (Cohen, Manion & Morrison, 2011). In order to gain some insight and understanding of the issue, documents were the first to be analysed in preparation for interviews so as to position me well to probe for reasoned questions.

The following documents were analysed:

- Policy document: The main document analysed was CAPS. The focus was on how the policy guides the teaching practice;

- Examiners' Reports: Reports from 2009-2012 were analysed to ascertain the status of public reports that analyse candidate performance question by question to provide feedback, as well as an improvement plan for educators and subject advisors to better teaching and learning;
- National examination question papers/Provincial papers: Analysis of the language of assessment for readability as well as context;
- Textbooks: These assisted me in the analysis of presentation of content, readability and accessibility, and language of Life Sciences textbooks and helped me understand how educators use these to enhance learning;
- Teachers' lesson plans (Appendix 5); and
- Learners' workbooks: These were helpful in the analysis of the true reflection of learners' responses for validation of my claims.

The first three documents were used to contextualise my study.

3.4.2 Key format interviews

Interviewing is a valuable assessment tool as it allows the participants to share their experiences, attitudes, and beliefs in their own words. In this study I interviewed two Life Sciences teachers from previously disadvantaged schools in the township and from a rural area. My decision to interview these educators was influenced by the different contexts of the schools as I wanted to get a broader view on how teachers assist learners in understanding Life Sciences concepts at these schools.

Furthermore, these teachers have extensive experience at a national level as markers, senior markers and chief markers which meant that their level of insight into marking experience for validity and verification of my findings would be advantageous. They also had extensive classroom experience. These interviews were used to gather foundational information on the teachers' views of teaching second language English learners, as well as how they assist learners in conceptual development (see Appendix 4). The teachers responded to the following sub-questions in this study:

1. What are the Grade 11 Life Sciences teachers' experiences and views on second language learners' challenges in understanding Life Sciences concepts?
2. What pedagogies and strategies are used by Grade 11 Life Sciences teachers in assisting second language learners to make meaning of scientific concepts in Life sciences?

Semi-structured interviews were conducted first and later I used stimulated recall interviews with the teachers while watching video recordings of the lessons they had taught. The interviews were conducted outside of the classroom. Each interview was done individually, and the interviews were conducted in English. Teachers were given the option of providing responses in the language they felt most comfortable with.

In this qualitative study, semi structured interviews were conducted to enable the researcher to gather data through conversations. This allowed for direct contact with the respondents in the investigation to help in data gathering. Lupele (2004) describes interviews as a tool for gathering data through conversation between the researcher and the researched. Lupele notes that while the most common form of interviews involve those with individuals, face to face verbal interchange interviews can also take the form of group interchange, mailed, self-administered or telephone surveys. I used face to face interviews, as well as follow up telephone calls in the case where there was a lack of clarity on certain points from interviews.

This data generative method allowed room to ask questions in a more informal manner and allowed for some of the responses to be probed further (Van der Mescht, 2011). Semi-structured interviews also provided a degree of freedom to vary the direction of interview based on participants' responses. Qualitative interviews are characterised by open-ended questions (Yin, 2011). According to Yin (2011), open-ended questions enable the researcher to get insight into what the participants perceive about the phenomenon being investigated. In the case of this study open ended interviews enabled me to rephrase questions, explain and add to questions during the course of interviews.

Walford (1991) argues that interviews are treated as prime data in many social science studies. In this study interviews were used as additional sources of data and for verification of other sources of data. These were recorded and transcribed verbatim so that information was captured as is.

This assisted in recording as much detail as possible for data analysis as noted by Patton (1990). The copies of transcripts were later given to the teachers concerned to verify their responses.

3.4.3 Observation

Observation is another means of collecting qualitative data with the objective being to collect data in a natural setting since the data is collected first hand (Cohen, et al., 2011). Cohen, et al. further note that observation gives the researcher an opportunity to get live data enabling the researcher to look at what is taking place. Direct observation according to Cohen, et al. also enables the researcher to find out if people do what they say they do or behave the way they claim to behave. Lupele (2004) notes that observation is an omnibus field strategy as it simultaneously combines document analysis, direct participation, observation and introspection.

Initially, I intended to observe at least five consecutive lessons per teacher to enable me to follow the course from the introduction of the concept to the conclusion of the concept. I only managed to do that with School 1, while with School 2 the timing was difficult as it was already close to the June examinations. Upon rescheduling my visits for the next term, I was only able to observe three lessons, since the teacher seemed pressurised by the situation.

These observations were made in order to identify the methods and strategies used by the teachers in assisting learners to make meaning of Life Science concepts responding to the question:

What pedagogies and strategies were used by Grade 11 Life Sciences teachers in assisting second language learners to make meaning of scientific concepts in Life Sciences?

The observations were captured using a video camera to record every detail of the strategies used to support teaching and learning in Life Sciences. These were then transcribed (see Appendix 6). Video capturing provided the opportunity to grasp finer details that would have been missed if I had relied on note taking only. Video recording also enabled the capturing of use of non-verbal cues where body language, such as affirming nods or puzzled facial expressions, assisted in explanation of certain concepts. However, writing notes and capturing the video on my own was not easy and as a result I relied mostly on the video recording. I initially viewed them on my own and later did so with educators concerned during stimulated recall interviews. Watching these

videos on my own enabled me to replay certain sections in order to observe which strategies were used, what they were used for and how they were used.

Viewing these video footage also enabled me to note in significant detail the ways in which the teacher implemented his/her pedagogical plan and helped me answer the question of how these plans were used to support learning and how learning was guided to support understanding of the concept under study. This served as a basis for discussion of best practices later during stimulated recall interviews. Yin (2011) suggests that the strength of observation is that it gives direct access to social interaction and has a potential to produce more valid data. In light of this idea classroom observations were conducted in the two selected schools.

3.4.4 Stimulated recall interviews

The stimulated recall interviews (SRI) were conducted while watching some sections of the videos clips with the two educators as I wanted the participants to reflect on their intentions in selecting certain pedagogical strategies in assisting learners. Teachers were interviewed separately. Questions were prepared in advance to guide the interview but the order of the questions was not necessarily followed during the actual interviews. Some new questions arose in the interview itself as I wanted to probe more to get clarity. I used examples of activities given by the teacher to learners during the lesson, pictures of interactions taken during these activities and at times we referred to the video clips for further clarity which were all used as stimulants for recall. These interviews took longer than semi-structured interviews as at times we engaged in lengthy conversations and had to refer to the video clips.

Watching the footage together with the teachers concerned stimulated further conversation and reflection on the practice. The filmed material provided a mirror enabling teachers to establish whether use of a certain method was successful or not. It also provided food for thought for the teacher's own teaching development. As an example, teacher 1 realised that she allowed the most outspoken learners to dominate group discussions and presentations thus giving less attention to the quieter learners. The teacher recognised that the results of this type of teaching scenario could lead to even less engagement by quieter learners, since they may feel their contribution is not needed, and ultimately this would leave them at a disadvantage in the classroom. Lyle (2003)

suggests that a stimulated recall interview is an introspective procedure. In addition, the use of stimulated recall interviews lends itself to being a validation technique as well.

3.5 Data analysis

Strauss and Corbin (1990) refer to data analysis as a process that involves breaking down, examining, comparing, conceptualising and categorising data. Henning, van Rensburg and Smit (2004) echo a similar view in that they refer to data analysis as the breaking down of data into manageable pieces through categorisation. This enables the researcher to identify themes, patterns and regularities and to make meaning of the data (Cohen, Manion & Morrison, 2007).

In this study coding was used representing a gradual building up of categories and sub-categories. This was done by reading across all transcripts using a constant comparative approach. During coding data was constantly revisited to ensure that categories genuinely emerged from data and were not imposed (Patton, 1990). An inductive approach was then adopted and the data were interpreted using Vygotskian mediating tools (see Section 2.6).

Evidence of mediation as well as mediational tools used to enhance learning was noted. Similarly, evidence of learning interactions (between teacher and learner, and learner and learner/activities) was also noted. The categories which emerged from the collected data were highlighted using colour coding for each category (Appendix 1). This helped to draw an analytical memo for each data source providing a systematic approach to organising the data (Appendix 2). These analytical memos enabled me to reduce data by generating analytical statements from them.

A summary of data generation methods is represented in the table below.

Table 2: Summary of data generation methods

Index code	Research technique	Research instrument	Appendices	Data	Questions answered
Doc-A1	Document analysis		8	Contextual profile	Question 1
Int1(T1)	Semi-structured	Interview	4	Educators'	Sub-question

Int 1(T2)	interviews	schedule		experiences and views on teaching second language learners • Strategies used to support learning	1 Sub-question 2
OB(T1) OB(T2)	Observation	Observation Schedule	9	Methods and Strategies used to support learning	Question 1 & sub-question 2 & 3
Int2(T1) Int2(T2)	Post-observation interviews	Interview schedule	7	Reflections on use of strategies in supporting learning	Sub-question 2 & 3

3.6 Validation and trustworthiness

Data was generated from interviews, the analysis of documents as well as from observations. The use of various data generation methods in this study provided opportunities for corroborating evidence from different sources thus providing better insight into the issue under study. Creswell (2012) refers to this method as triangulation. Triangulation enhances understanding by enriching information using one type of data to validate the other. Denzil and Lincoln (1998) assert that no single method ever solves research investigation adequately.

Data from interviews were transcribed as discussed in Section 3.5 above. Copies of transcripts from these interviews were given to the teachers concerned to verify if it was the correct representation of their ideas. Data from observation was also transcribed. Both teachers were given the option to keep the transcripts for a day or two and to go through them at their own time. This is what Leedy and Ormrod (2010) refer as member checking. Finally, as explained, stimulated recall interviews also contributed to data validation in this study.

3.7 Ethical considerations

The following ethical issues were considered in this study.

3.7.1 Negotiation of entry and informed consent

Before conducting the study, an appointment was secured with the district official assigned to the area in which the schools are located to request permission to carry out my study in these schools. During the meeting I explained the intentions of the study and promised accessibility to the studies should they wish to use them for developmental purposes or any other purposes they deemed fit.

Cohen, Manion and Morrison (2007) suggest that it is important for the researcher to obtain informed consent with the participants when conducting a study, and for the participants to understand the background and purpose of the study. I fully revealed the intentions of my study to the participants, and asked permission from the school principals to use their schools in this study. The principal, the teachers concerned and learners were alerted in advance that devices such as tape and video recorders were to be used to capture information. I assured the respondents of anonymity and confidentiality regarding the information gathered, both during the period of data collection as well as for the future use and possible publication of the research. I gave the participants consent letters to sign as proof that they participated willingly in the study (see Appendix 3). Learners were requested to take these consent letters to their parents. These letters also indicated that respondents reserved the right to withdraw at any time without any obligation to explain why. Creswell (2012) suggests that it is essential to request permission before using or entering any site.

3.7.2 Voluntary participation

The respondents as well as the schools were given an option to withdraw from this study should they feel uncomfortable, or for any other reasons. This was evident when I wanted to push for more lessons from school 2, and the teacher concerned felt pressurised, resulting in my observation of fewer lessons than previously planned.

3.8 Limitation of the study

The focus of the study was limited to two schools in the East London district and can therefore not be generalised. Initially, I had hoped to observe five consecutive lessons per school but I only managed to do that in School 1. Time constraints did not allow for more.

Presence of the observer and use of capturing devices in classroom settings may have influenced the normal behaviour of learners as well as educators and thus pose a challenge on the true reflection of the state of affairs. Cresswell (2012) refers to this as an obverse effect which influences reliability of data collected. It was difficult to strike the balance between a measure of objectivity and trying to put the respondent at ease, as the researcher was familiar with the respondents. Creswell (2012) concurs that collection of data through interviews involves a complexity of social relationships that could affect the final product. Information could be distorted and open to unconscious bias on the part of the researcher.

3.9 Concluding remarks

This chapter took us through the journey of how I explored my research question and topic. It focused on the research design and methods that I used to generate data, details of how I have gathered, analysed and interpreted this data to assist me in answering my research question. I have also discussed how validity and trustworthiness of the findings were considered.

In the next chapter I present my data.

Chapter 4: Data presentation and analysis

4.1 Introduction

The main aim of this study was to explore how Grade 11 Life Sciences educators make meaning of biodiversity concepts for English second language learners. This chapter presents data gathered from the two schools in East London where the study took place. The data presented consists of a preliminary analysis from semi-structured interviews, documents, lesson observations and stimulated recall interviews. For ethical reasons, pseudonyms of both schools and teachers are used in this study and these are referenced as School 1 and School 2, Teacher 1 and Teacher 2 below.

The discussions in this chapter will start by looking at the participants and class profile. The chapter further presents data from documents analysed. This is followed by presentation of data from semi structured interviews, observations and stimulated recall interviews. The chapter will give concluding remarks at the end.

4.2 Participant and class profiles

The table below presents a summary of the profile of the participants and class profiles. The data indicates that both teachers have extensive experience in teaching biology as a subject. They are both qualified to teach the subject. Their experience in the field of teaching implies that they have passed through all the phases of curriculum changes in the subject from NATED 550, OBE, NCS to CAPS (see Section 2.2.1).

The language of teaching and learning in both schools is English but the languages used in the class are English and *IsiXhosa*. This implies that although the instructional language is supposed to be English there is flexibility of moving from English to *IsiXhosa* (the home language of the learners) when a need arises. This will be reflected when presenting data in Sections 4.4, 4.5 and 4.6 below.

The class size for School 1 indicates the challenge of overcrowding According to the latest regulation in South African schools, the ratio is supposed to be 1:30 (DoE, 2011). In both

schools they exceeded the requirement which could pose a challenge for management of the class. Table 3 below illustrates teacher and class profiles.

Table 3: Illustrating teacher and class profiles

	Age	Teaching experience	Qualification	Gender	Teaching experience in subject	Class size	Subject majored in	Official language of teaching and learning	Language used in class
Teacher 1	39 years	14 years	B.ED, ACE EE	Female	14 years	77	Geography and Biology	English	English and <i>IsiXhosa</i>
Teacher 2	45 years	22 years	Secondary Teacher's diploma (STD), B.ED	Male	22 years	45	Biology and Physical Science	English	English and <i>IsiXhosa</i>

4.3 Curriculum analysis

4.3.1 CAPS document

I started by analysing the Curriculum and Assessment Policy Statement (CAPS) document (CAPS 2011). The CAPS document is the current policy document that informs teaching in South African Schools. It is a document that provides guidelines on what teachers should teach in order to develop learners' understanding of certain topics, which in this research is the topic of biodiversity. The document was analysed to get an idea of the curriculum expectations and how these could possibly guide teachers' choices of supporting strategies used in helping learners make meaning of biodiversity concepts. Table 4 below illustrates a summary of key biodiversity related topics within CAPS Life Sciences with assessment focus, and subject aims.

Table 4: Summary of biodiversity topics, cognitive skills, assessment focus and subject aims

Biodiversity topics	Grade	Cognitive skills	Key assessment focus	Subject aims
Definition of biodiversity concepts, Biosphere, Biomes Ecosystem and Diversity, change and continuity	10	Knowledge of biodiversity terms and concepts, phenomena and processes	Define and describe aspects of biodiversity	Knowing Life Science (Biodiversity concepts) (SA1)
Population ecology Impacts of humans on biodiversity	11	Observe and Identifying role of biodiversity into the environment (interactions) Identify and investigate a situation of a local issue that affects biodiversity	Interpret biodiversity information suggest reasons for and effects of human impact and use this knowledge to design solutions	Investigating a phenomenon in Life Sciences (SA2) Appreciating and understanding the history, importance and application of Life Sciences in society (SA3)
Human impact on the environment current crisis	12	Explore biodiversity and human impacts	Discussions on implication of human impact	Same as above

The CAPS document sets direction in teaching and learning biodiversity from grade 10-12 as indicated in the table above (see also Section 2.2.2). The document entails guidelines which include the content to be taught, skills to be developed and specific aims to be achieved when dealing with Life Sciences.

There is not much direction on how to teach specific content and this gives teachers the freedom to design and organise learning according to their needs and circumstances. However, if one looks at the specific aims and cognitive skills to be assessed in Life Sciences they do implicitly suggest certain methods that can be used when dealing with topics like biodiversity. For

example, Specific Aim 2 is about investigating certain phenomena in Life Sciences and this suggests that it is a practice oriented aim. If one seeks to achieve that in teaching biodiversity, methods like investigation, experimentation, learning by doing and deliberation may be used (see Section 2.4).

On the issue of language, CAPS explicitly specifies use of certain verbs like state, describe compare, predict and so on in assessing learners' knowledge, understanding and application of scientific concepts, and evaluation and synthesis of scientific knowledge as described in the key assessment focus tabled above. These demand cognitive academic language proficiency. CAPS states that Life Sciences teachers should see themselves as language teachers across the curriculum and should provide learners with opportunities to develop and improve their language skills in the context of learning Life Sciences. Biodiversity, as a life forms and life systems concept, is a complex scientific concept which requires development of scientific literacy. The Life Sciences' aims, cognitive skills and assessment focus tabled above give an indication of which key verbs to use when assessing biodiversity concepts but does provide an explanation of *how* this assessment should be undertaken.

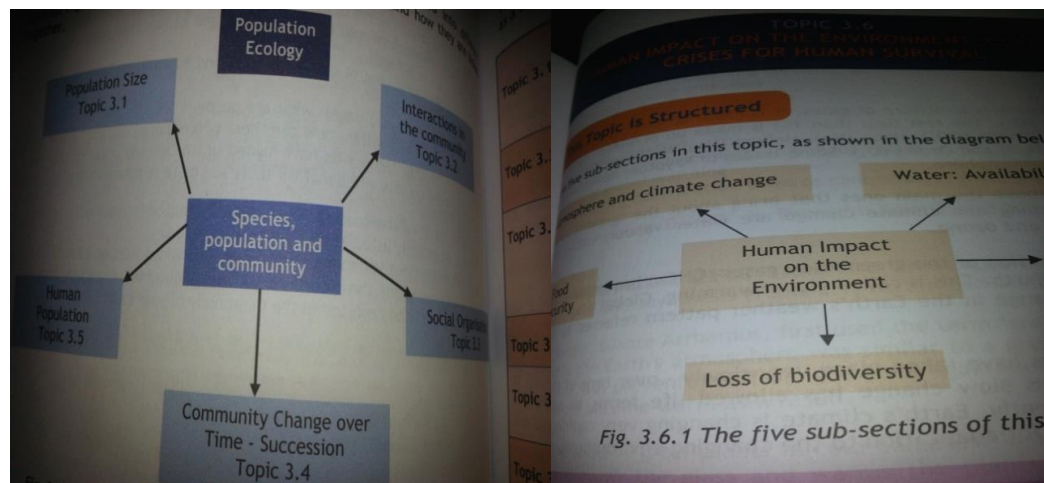
4.3.2 Textbook 1: *Understanding Life Sciences* Grade 11 (1st edition)

Teachers in both schools indicated that they use *Understanding Life Sciences* textbook as a resource for learning while also using a range of other sources for references and complementing knowledge provided in the prescribed book. Their reasons for selecting this textbook seemed to be exam orientated as they explained that most of the activities that appear in this textbook are examples that also appear in the exams. When asked about their reasons for selecting this book, one participant responded:

My choice of textbook is based on the number of activities that I can use to engage the learners in preparation for exams. Most of these activities appeared in the previous exam papers. As you know we are writing a common provincial paper in grade 11. I want my learners to get used to the kind of questioning so that they do not struggle answering questions during exams. Another thing... the writers here include national moderator provincial moderator of Life Sciences (Int2 T2-In 45-51).

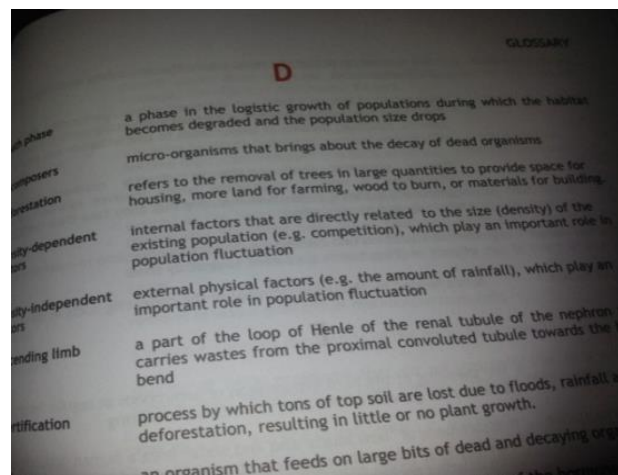
Knowledge on biodiversity in this book is presented in two knowledge strands. Strand 1 relates to biodiversity, change and continuity, while strand 2 is concerned with environmental studies. At the beginning of each strand an outline of topics to be studied is presented in a mind map showing the interconnectedness of these topics and sub topics. Below is an illustration topic outline from this textbook.

Figure 1: Illustrating representation of topics and their interconnectedness (mind map)



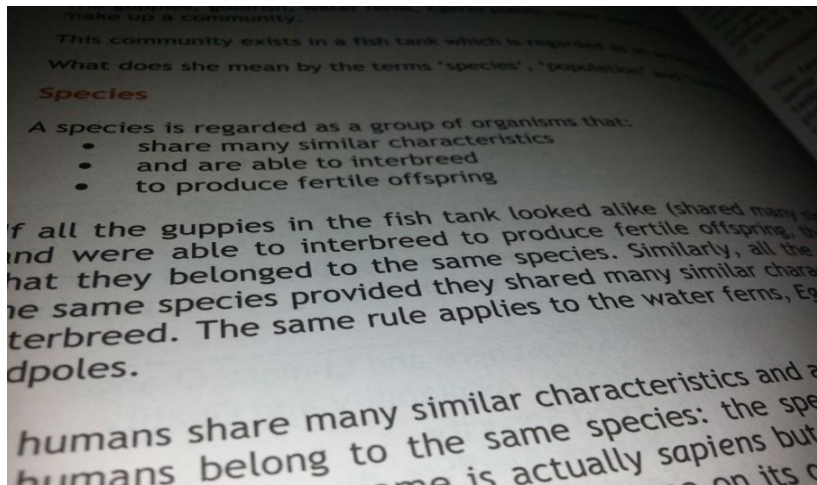
The glossary of all the terms in this textbook is presented on the last page of the textbook. Terms are arranged in alphabetical order which makes it easy for a learner to find them.

Figure 2: Illustrating glossary of terms in alphabetical order



Key terms for each concept discussed in a topic are highlighted in bold which attracts the attention of the reader (see Figure 4.3 below). The highlighted terms are often described in point form as seen below emphasising the important aspects of the definition.

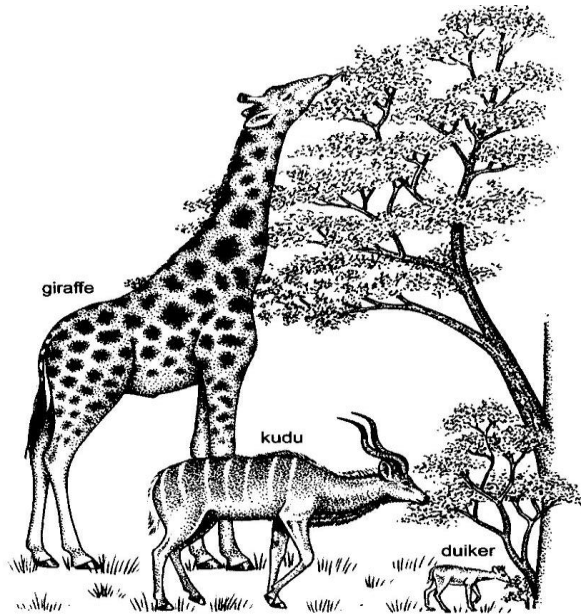
Figure 3: Illustrating description of terminology in point form in the textbook for easy readability and comprehension



In most cases, an example or picture that further explains the term is given to illustrate the concept. In the above definition of a species, guppies in a fish tank which all look alike are used as an example to explain what a species is. In trying to understand the term species a learner can use this example to make meaning of this complex concept.

Use of pictures can scaffold learner understanding of written explanations which can be useful in overcoming language barriers as they provide a visual rather than a vocabulary based text. For example, the picture below in Figure 4 is used to illustrate two complex concepts when teaching biodiversity: The concept of **inter-specific competition** and the concept of **resource partitioning**.

Figure 4: Inter-specific competition and resource partitioning



The concept of inter-specific competition is defined as the competition between organisms of different species over the same resource. The picture above illustrates three organisms of three different species sharing the same resource. By looking at the activity (competition) of the three different animals (different species) feeding on this tree (resource), a learner will be able to relate the definition of the term to the activity shown in the picture which, helping to simplify the meaning of the text.

Moreover, the different organisms are illustrated eating leaves on different levels of this tree. They are using the resource slightly differently enabling them to co-exist in the habitat while minimising competition amongst different species. This phenomenon is known as *resource partitioning*. In this case, the picture serves a double purpose, the first is the illustration of two different complex concepts with a visual explanation, and the second is providing opportunities to explore the language needed to explain such concepts. If a learner fails to understand the written explanation the picture has the potential of serving as a source of support. A learner can make meaning of the written text by using what he/she sees in the picture.

Furthermore, pictures that are used in this textbook represent indigenous South African animals which can be used to trigger relations between prior knowledge and new knowledge thus helping the learner to make meaning of a complex concept. The biodiversity sections in this textbook

include a variety of activities ranging from case studies to data response questions and the use of contextual issues encourages debate and engagement around the issues at hand (see Appendix 4 D1).

Data from this textbook revealed how content knowledge is made accessible through the use of illustrations to support learner understanding. In addition, the textbook focuses on South African examples to describe environmental issues which enable learners to relate more readily to the text. The range of activities used expose learners to various forms of questions that give learners opportunities to practice such questions and familiarise themselves with the kinds of questions they may encounter in examination questions. All in all, this seems to be a user friendly textbook.

Data analysed enabled the researcher to understand how the choice of textbook can assist learning. It also partly answered the question of how grade 11 educators mediate learning of biodiversity concepts to English second language learners.

4.3.3 Learners' exercise/activity books

Learners in School 1 use separate books for class exercises as well as for writing notes. Notes were given as a summary of what was taught as well as a way to help with correct spelling of words. At the time of my observation, while working with the topic under study, not much use was made of the exercise. I did, however, look at the previous topics to get sense of the teaching methods used in this school. Exercises were prescribed by the teacher, with information sheets handed out to help the learners complete these exercises. At other times textbooks were used to search for information while working on the exercises. Most activities were done in groups and posters were used to present group activities given during lessons. When asked how they engage their learners the teachers indicated that:

T1: My learners use separate books for taking notes and classroom activities. It is important for them to take notes as I simplify what I am teaching in my notes. I write a summary of what I am teaching on the chalkboard for learners to copy and write. It is important for them to copy the correct spelling of terms (Int2-T1-ln37).

T2: I use the same exercise book for both note taking and activities that I give to my learners. This helps them to use the notes as source of reference. Writing notes assist learners to read and write correct spelling of words given that they may have missed when I am talking. I also encourage them to paste the handouts on worksheets to be completed on this exercise book. They refer to their notes to complete these activities. These help them when they study for tests and exams for easy reference and revision (Int2-T2-In25).

The statements above indicate that notes are purposefully given to engage learners in reading and writing that is meant to assist in grasping the correct spelling of words. Worksheets are used to scaffold learner ability to respond to questions as they act as a source of reference as indicated by T2 in the above statement.

Learners in School 2 use the same book for writing notes and answers to exercises given. Learners use the chalkboard summary as notes. These are simplified version of the content of the concept being studied. The activities given are written after completion of a certain subsection of the concept under study. This is a purposeful arrangement to assist learners to use their notes when confronted with difficult questions to answer as indicated in the statement above.

Most of the class activities given by Teacher 2 were taken from the textbook. These activities consisted of a variety of questions which required production and application of knowledge. The teacher guided the marking of activities by supplying correct answers on the chalk board but the actual marking was done by learners and the teacher appended signature after marking. Learners made corrections by copying given answers. There were no comments or suggestions made on wrong answers given in their activity books. This could leave learners with no indication as to where they have missed the correct answer.

4.3.4 Lesson plan analysis

A lesson plan is a structured tool that guides teaching. Teachers in South Africa are required to plan their lessons in advance. To support teachers in Life Sciences in planning their daily activities, teachers are supplied with the CAPS document, examination guidelines, a work schedule and lesson plan template to guide them when making their personal lesson plans.

The CAPS document is meant to give teachers guidelines as to what content to cover in each topic as well as what skills to assess guided by the subject specific aims (see Section 2.2.1). The examination guidelines give more clarity on the depth and scope of content to be assessed assisting teachers to adequately prepare learners for examinations. The work schedule that is included in CAPS outlines the scope of content to be covered, time frame in weeks to cover each topic, possible activities to be employed during teaching and suggested resources to be used. Lesson plan templates guide teachers on how to structure their lesson plans. The table below indicates some of the aspects that appear in the template as supplied by the Department of Education.

Table 5: Illustrating structure of lesson plan for both teachers

Grade:		Subject:	Week:	Topic:	Lesson no.
<i>Indicated in both schools</i>		<i>Not indicated in school 1</i>	<i>Not indicated in both schools</i>	<i>Indicated in both schools</i>	<i>Not indicated in both schools</i>
Lesson objectives	<i>Not written for school 1 but included in school 2</i>				
Lesson summary	<i>Not written for school 1 available for school 2</i>	Date started	<i>Not indicated in both schools</i>	Date completed	<i>Not indicated in both schools</i>
Teachers activities			Learners activities	Timing	Resources needed
• Introduction • Body of the lesson • Conclusion • Homework	<i>In school 1 lesson is not divided into sections but into the activities that she plans to engage learners on</i> <i>In school 2 lesson is divided into sections</i>		<i>Both lesson plans explain how learners are to be engaged in the process of learning</i>	<i>Lesson plans for T1 indicated how much time will be spend in these activities (Time in minutes)</i>	<i>Both lesson plans indicated what teachers are going to need to support learning.</i>

The primary function of lesson planning is to guide the teacher in their teaching by helping them describe what they want to achieve by the end of the lesson. The teacher should ask questions

like: What knowledge and skills do I want the students to obtain?; What would I like my students to learn?; What do I want them to be able to do? The lesson objectives describe and make clear the intended learning outcomes and become the foundation for selecting learning activities and assessment measure.

However, as indicated in the table above, no mention is made of teacher 1's desired objectives for the lesson, and the plan lacks some of the basic aspects that should appear in a lesson plan (LP-T1). The lesson does not show a clear outline of how the lesson is to be developed, and lacks clarity in the introduction to the lesson, how new knowledge will be presented, and how the lesson will be concluded. This lack of objectives may affect the structure of the lesson. The lesson does, however, entail a clear description of what students will be doing in the lesson with specific time allocated for each activity, and details on how they will be engaged. Most of the activities that appear on the plan are group activities. There is no indication of individual class work or home work.

The lesson plan for Teacher 2 indicates a progression through the lesson from introduction to conclusion (LP-T2). The objectives of the lesson are indicated as outcomes with the teacher indicating what it is he wishes his learners to achieve by the end of the lesson. Specific knowledge and skills that the teacher wishes the learners to achieve are clearly indicated in his plan. The plan does not indicate how much time will be taken to cover the topic, which is contrary to the examples the DoE typically supplies, which indicate the number of weeks to be allocated for each topic. Time allocation may assist the teacher in keeping up with the academic schedule and prevent them from falling behind. In my opinion a time bound plan helps the teacher focus on timeous completion of the teaching and learning goals, and helps avert being swamped by day to day teaching crises.

4.3.5 Concluding remarks

Although both teachers have extensive experience in teaching, their lesson planning reveal gaps in their planning phases, leaving room for improvement.

4.4 Interviews

In the second phase of data gathering, interviews were conducted with both teachers from the two schools participating in the research. Semi-structured interviews were conducted before lesson observations in order to collect foundational information on the teachers' views of teaching second language learners and how they assist learners to make meaning of biodiversity concepts. After the lesson observations, stimulated recall interviews were conducted to allow teachers to reflect on their choice of pedagogy and use of certain strategies over others in making meaning of biodiversity concepts. Semi-structured interviews were used to answer the following research sub-questions:

1. What are the Grade 11 Life Sciences educators' experiences and views on learners' challenges in understanding Life Sciences concepts?
2. What pedagogies and strategies are used by Grade 11 Life Sciences educators in assisting second language learners to make meaning of scientific concepts in Life Sciences?

The following challenges were indicated from interviews. The profiles of the schools presented above in Section 4.2 indicate that English, which is a second language in the schools, is used as the medium of instruction in both schools. When asked how this affected their students' learning, both teachers indicated that:

4.1.1 Learners struggle to make meaning of biological terms during lessons because of the language

The conversation below indicates how these teachers responded to this issue:

T1: Yes, since my learners are from IsiXhosa speaking background it becomes difficult for them to understand certain concepts as they make spelling mistakes which have meanings that are totally different from what they are trying to explain. For example they will write lite instead of light, advantages instead of adventitious roots. Once such mistakes happen they cost them marks (Int1-T1-ln28-32).

T2: Yes, it becomes a problem because you will try and explain something and you see they are just blank they have no clue of what you are talking about and you end up taking a long time trying to explain one thing but once they get it they flow. Learners have poor understanding and

mainly spelling mistakes. Even though we are not that strict in marking spelling in Life Sciences once the wrong spelling of the word changes the context of the word, the learner is marked wrong which cost them marks. Like in describing or identifying the phases of growth in population growth forms they normally write leg phase instead of lag phase. If a question requires them to explain or discuss they normally leave it. Not that they do not have the content but they can't express themselves. That cost them a lot during exams as such questions are heavily weighted (Int1T2-In21-30).

The discussions above show that English as a second language poses serious problems for learners as they fail to make meaning of biological terms. Teachers point out that affects their ability to effectively express themselves in responding to questions requiring explanation or discussion. The regular occurrence of spelling mistakes with similar sounding words also indicates a failure to make meaning of concepts. The examples given by both teachers (lite/light and lag/leg) bear testimony to this. In most cases an incorrectly spelled word changes the meaning leading to incorrect definitions and answers.

4.4.2 Learners fail to interpret questions correctly during exams and as a result they give incorrect answers

When further probed, teachers also indicated that certain types of questions posed during exams are challenging for learners to interpret and answer. In particular, data response questions, which require learners to interpret data provided leave learners at a loss. The conversation below indicated the challenge that learners have in interpreting questions:

R: Life Sciences has language of its own which is normally assessed where learners are required to interpret information in data response questions. How do your learners respond to these?

T 1: Yes, some questions during exams are based on a scenario or they will be given data in a form of a table or graph. If the learner is unable to interpret and understand the content of the scenario or graph that learner finds it difficult to answer such questions (Int1-T1-In41-43).

T2: In most cases data response questions are left un-attempted. I am not sure whether they get scared of these questions or what. It becomes worse when they are asked to formulate a hypothesis and predict the results of the experiment given. Let alone distinguishing between

dependent/independent variables. They will state the aim instead of a hypothesis and put the independent variable in the place of dependent variable or vice versa. You can just see they have no clue of what these words mean.

From these statements above it is evident that teachers are aware of the difficulty learners face in reading, understanding and responding to data response questions.

4.4.3 Biodiversity consists of a variety of complex interrelated terminology that can confuse learners if not properly grasped

From the documents analysed, biodiversity is a wide ranging concept which runs across two out of four knowledge strands in Life Sciences - Diversity change and continuity, and Environmental Studies. The wide scope of content in these knowledge strands indicates the complexity of this concept. When asked for their views on this topic, teachers responded as follows:

R: The two strands biodiversity, change and continuity and environmental education introduced some new topics on evolution of species and environmental issues that should be learnt in all grades. How do you find these topics?

T1: Interesting indeed.

T2: Well not so bad when you have the content. The problem is that some of the topics were not part of our programme when we were trained as teachers like evolution and climate change which needs you to understand it first before delivering. It goes with one's attitude because, if you do not know, you must consult other sources like people who know better or just search for information from reliable sources.

R: How confident are you in teaching this new content?

T1: I am very confident now but at the beginning I was scared to tackle this topic because I had not been exposed to this kind of content before. But attending a workshop on biological evolution presented by Mr X from Grahamstown whilst I was teaching at Bisho High... it capacitated me a lot on this. My other advantage is that I am a Geography teacher some of these topics we deal with them in Geography I normally apply my Geography knowledge especially on things related to climate even though some concepts are new to Geography as well (Int1-T1-In58-66).

T2: Not confident at all when I started teaching evolution and environmental issues like climate change because I was not so sure of what I was talking about even in the CAPS workshops we had when CAPS was introduced the presenters seemed to have little knowledge or no clue. We had some guest presenters later on in our workshops in the district and I became more confident.

R: How are your learners responding to this topic?

T1: Not so good. There are a lot of interrelated terms used in these topics which they often miss when not properly understood. It needs one to draw a distinction between these closely related terms. For example there is a fine distinction between intra-specific competition and inter-specific competition. Learners need to understand that when is intra it's between the same species but inter between different species it becomes easy for them to confuse such. Another thing is that most of the terminology link with other chapters in other knowledge strands. If a learner fails to link such terms with the explanation in previous chapters such a learner will have some problems in understanding the whole concept of biodiversity. Learners have a tendency of learning topics separately from each other instead of continuity (Int1-T1-ln68-77).

T2: The topic is vast and complex. There is so much terminology that learners are supposed to know and understand. Some definitions are closely related which learners often mix up and end up giving wrong answers. It becomes worse when they have to discuss these issues in examination they just do not have enough words to express themselves and they fall short in their discussion. Not that they do not have content but they struggle to put this in correct language because if we talk about these in class discussions where they sometimes use their language they just flow but when it comes to writing they get stuck (Int1-T2-ln61-67).

From these discussions, both educators and learners seemed to find these topics complex. The teachers implied that a lack of content knowledge on this topic affected their confidence in teaching of the subject.

4.4.4 Large class sizes make it difficult to manage classes and give individual attention

Table 2 (above) of the schools' profiles highlighted the large class numbers. When asked how they manage these numbers teachers referred to a range of problems they encounter which may affect their teaching. The following are some of the responses from these teachers:

T1: It is difficult indeed. You have to be a disciplinarian to manage. Quite honestly it's difficult to do justice as you cannot give individual attention. For class exercises they mark themselves. I just can't mark all the 77. I only mark their tests and exams. I rely most of the time on group work when I give class activities. I then take one sample from the group and then the rest will do corrections from that. If I want to do practical I take them in groups like I divide the class into 3, then assign different days for their practical. It really consume a lot of time that I have to sacrifice my afternoons and weekends if I want to finish the syllabus (Int1-T1-p-46-5).

T2: It is not easy at all but it's better than my grade 10 because I have 65 in one class. It's difficult to have one-on-one attention. It becomes worse when you have to do practical they become so playful. I normally do my practical after work or during weekends and I arrange with one of the teachers from my cluster to help so that there is somebody helping me. In some cases I take group leaders and do practical together where they will then be teachers in their own groups when we all gather together. In marking class works and homework I rely on peer marking. I normally mark test and exams (In1-T2-lin12-18).

From these responses it is clear that the size of the classes have an impact on teachers' ability to manage their classes. Teachers depend on alternative methods like group work and peer marking which could pose some problems when not properly managed. Lack of individual attention may disadvantage learners who tend to work at a slower pace.

4.4.5 Use of notes/chalkboard summary to emphasise correct spelling of words

In responding to the question on what strategies Grade 11 teachers use to mediate biodiversity concepts to English second language learners, both teachers indicated that they use notes to allow learners to read and copy correct spelling of words. The conversation below elaborates:

T1: I make sure I use chalkboard summary to write notes and words and explain so that they can get the correct meanings (Int1-T1- ln36-37).

T2: I make a short summary of what I teach so that learners can take note of right spellings. I often highlight the key words by underlining them. Note taking assists in reading and writing of correct words. When marking their test I make notes next to each wrong answer given so that the

learner may know where he has gone wrong. In class I highlight common mistakes I have identified and clarify confusions (Int1-T2-ln34-38).

4.4.6 Breaking down of compound terms to simplify terminology

When asked how they assist learners in dealing with complex terms, teachers pointed out that they normally break down these words to simplify their meanings.

T1: I normally break the words into the parts that make up the word because sometimes you will find out some words consist of 2 parts in it that you can break to make the meaning simpler. Let's take for instance biodiversity. You take the first part bio (life) then diversity - (different types of) then you combine the two to make a full description of the term. This makes life easier and they can use the same method in similar words they come across (Int1-T1-ln96-100).

T2: In science we are often confronted with big words and these can intimidate learners. I know this from experience. To minimise that you just break the word into parts that simplify the meaning like it becomes now much clearer than giving the full description. Like if you come across words like photosynthesis you just split the word Photo (light) Synthesis (make up) if the learner can understand the components of what the word is made up of then it becomes easier to connect if you had to relate the meaning behind the components of the word and this can bridge the fear of new strange words (In1-T2-ln69-75).

4.4.7 Contextualising concepts

Teachers seemed to find the use of context of the learner helping in making meaning of concepts. The conversation below elaborates:

T1: I use as many examples as I can to try and explain the meaning and I make sure I use examples that they are familiar with like you contextualise your examples. In that way they will be able to relate what you are trying to explain by referring to their context but you have to be very careful in this because sometimes they just understand the example more than the concept. I once experienced that when I use examples of Giraffes and Snakes in explaining Lamarks' theory of evolution with my grade 12 instead of explaining the theory they just give you examples. You find they followed the example more than the explanation (Int1-T1-ln102-108).

T2: I find it helpful to use learners' context to explain some complex terms. For example when I teach them about the effect of deforestation on biodiversity, I normally refer to mushrooming of shacks in their own area and how that might have affected biodiversity in their own area (int1-T2-In77-80).

Use of examples and context in this case is used to help learners relate and connect the new knowledge with what they are familiar with.

4.4.8 Use of prior knowledge

Teachers also indicated that they use prior knowledge to help learners to link previous knowledge to new knowledge. Teacher 1 strongly emphasised the importance of understanding the progression of Life Sciences content so that learners do not study concepts as single separate entities. The following conversation presents the teachers' views on use of prior knowledge:

T1: When I am starting a new topic I will check the previous knowledge from the previous grade so as to link the information that they have already done in the previous grade.

T2: I start by finding out what the learners already know about the topic. You give the learners an opportunity to share anything they might know about the topic. This also helps you to gauge what their level of understanding is before you jump into the topic and whether you can use this as a base to introduce the new topic (Int1-T2-In99-102).

When probed further on the necessity of use of prior knowledge when teaching, the response was as follows:

T1: Learners must not see information as bits of pieces but they must integrate it so that whatever they have done in the previous grade was just a foundation preparing for the most advanced stages they are faced with. They must link it because we have the same content for the FET phase because there is that progression from Grade 10-12. They must not see it as bits of pieces. There is a link. There is some progression. Grade 10 is a foundation then Grade 11 builds up on the work they have done so that they have the whole picture.

In noting the value of prior knowledge T1 responded as follows:

T1: I think they will fail to link it with the previous knowledge. This will create a gap now between what they already know and new information.

The above conversation indicates valuing of prior knowledge as a foundation for introducing new knowledge.

4.5 Lesson Observation

Lesson observation was done in both schools. I had planned to observe five consecutive lessons in both schools but was unable to follow through with that plan in the second school, as it coincided with a set school programme. The objective was to gather data in natural settings and complement data gained through the interviews in order to validate the research findings (see Section 3.4.3). The lesson observation helped me to identify pedagogy and strategies used by teachers in assisting learners to make meaning of biodiversity concepts, which was related to the research sub-question 2:

What pedagogy and strategies are used by Grade 11 Life Sciences educators in assisting English second language learners to make meaning of biodiversity concepts?

4.5.1 Teacher 1 - Lesson 1

This lesson, scheduled to take about 30 minutes, included four activities which required learners to work in groups and present the information to the rest of the class. The group discussions and presentations ran over into the next period at which point the teacher negotiated an extension with the following class in order to finish. The main topic, biodiversity and human impact on the environment, was introduced by mobilising prior knowledge through asking learners about terms related to the topic. This prior knowledge was used as a foundation upon which to build new knowledge. The teacher guided learners' use of prior knowledge in eliciting responses when defining certain terms. The following conversation (OB-T1 ln3-30) is illustrative of this:

T: Before we can start our topic I would like to find first if you know anything about biodiversity

L: Quiet (no answer)

T: You can say this in your own words don't worry about scientific explanation

L: Quiet

T: Ok let's try this (teacher writes on the chalk board) Bio what do you understand by this?

L: Bio means life

T: Good bio- means life. And then what about diversity?(teacher writes the word on the board)

L1: Different kinds of (pause)

L2: Different kinds of animals or plants

T: Yes diversity can refer to different kinds of plants and animals but not only plants but all life forms

T Let us combine the two explanations now. Who can help us?

L: Great variety of species

L2: Variety of plants and animals and organisms in a community

T: Yes biodiversity refers to great variety of life forms we have in nature including plants animals and also other small creatures like micro-organisms.

T: With biodiversity do we want so much, do we want great variety. Do we want more or less?

L: More (chorus)

T: Why is it important to have lots of biodiversity? Why can't we live with ten or less plants and animals?

L: We need them because some other species benefit from others, plants or animals depend on the other so if we do not have much some other plants or animals will suffer because there are no plants or animals that they depend on.

T: So you mean different species depend on each other for survival. If we have less some will not be able to survive. In an ecosystem where everything works together you take one thing then the whole ecosystem will collapse. Biodiversity also gives us resilience.

T: Does anyone know what this means? Another buzz word resilience

L: Blank, quiet faces

T: Resilience is the ability to withstand any kind of impact. For instance a very strong tree that has deep roots can withstand heavy winds (resilient from the wind) the tree bends in the wind (teacher uses body movements to show bending of the tree) and stands strong in the ground. With huge amount of resilience we stand ability to adapt to lots of different situations. With huge amount of biodiversity we have resilience. The most mistakes we make is to think we are separate from nature. Nature there, people there.

The teacher-learner interactions illustrated in the above conversation show how the teacher elicited learner responses through guided clues. When learners were unable to define biodiversity the teacher simplified the term by breaking it down into two parts which enabled the learner to come up with the full definition of the word complementing what the teacher suggested in interviews (int1-T1-ln96-100).

In the next activity learners were divided into groups of 10. Learners were moved out of the class because of space. Each group was supplied with a pack containing information sheets with pictures of different human activities. There were also strips of papers with terms and definition of terms. Learners were required to try and define the term in their own understanding at first and then compare their responses with the strips supplied. These were used to confirm their responses as well as guiding them towards a correct definition. The exercise was ‘*Match word with definition*’.

For this activity interactions went as follows (OB-T1 p 2 -ln 35-60):

T: Stick the word and search for the right definition from the packs. Let's see who is the first to finish.

Learners started by explaining some possible description of terms in their own understanding which resulted in some arguments and disagreement. For example the description of the ecosystem went as follows:

L: Ecosystem is whereby organisms live together in spite of their differences, their physical changes, or their looks.

One learner was reluctant to write down the proposed definition saying he was not happy with it.

L: I suggest that each of us come up with their own understanding of the term then combine our answer so that we come up with a common answer.

L: I think Yindawoyabo [I would say it is where] - it's where –where (emphasis on where) different organisms live and interact together. Oh! Unyanisileyindawomnandishiye lento ithi yindawo [it's true I have left this part that says its where]

L: Let's check on the strips

They verified their answer by reading out all the strips provided, and put aside the one they didn't agree on.

L: I think this one is correct listen guys (learner reads out loud) ...a community of organisms interacting with one another and their physical environment while functioning as a unit.

They all agree then the description is pasted next to the correct term.

A conversation from another group of learners went as follows:

L: Indegenouszezifumanekakulondawo zioriginate khona [they originate in that particular area].

They took a strip that read, "Organisms that grow naturally or originated in that particular area."

L: Ok guys let's move this from here it does not belong here this means we still have to look for the meaning of this word (apparently they had already pasted a wrong description next to "indigenous")

The teacher was called to view the finished activity and verified their word by nodding if it was fine.

Evident in this interaction were learners trying to help each other to make meaning of these terms. Learners were allowed to switch from English to their own mother tongue during these interactions, creating a more relaxed mood for engagement. In the activity above learners were given an opportunity to try out these definitions relying on their prior knowledge. Interestingly,

bringing in their own understandings about each term brought about some tensions. There were some disagreements around certain terms as illustrated in the conversation above. These were eased by use of strips of papers with definitions to verify the answers. In addition, knowledge relating to these terms was reinforced through presentations.

This activity was followed by group presentations which were used to share information and to learn from each other. The presentations, however, these were dominated by strong learners. The teachers' role was to reinforce learning by emphasising what the learner had said or by adding some missing information. Learners were then required to keep their completed exercises to use in the next activity. Figure 4.6 below is an illustration of an activity, “*match a word with description*”.

Figure 5: Illustrating learners interacting with the activity and with each other matching the word with its description



In the next activity the teacher reinforced learner knowledge and use of the biodiversity terms learned in the previous activity in the context of human impact on the environment. Learners in each group were given reading information about Eastern Cape biomes, a map illustrating where these are found in Eastern Cape, pictures of plant and animal life in these biomes, as well as pictures showing human impact and ecosystem services. Each group was assigned a different biome. Learners were then required to study the pictures in their packs and decide which biome these pictures represented. The readings were used to assist them in this regard. Learners were also required to use pictures to identify human benefits on ecosystems and human activities in the biomes and how they impact on biodiversity.

The following conversation (OB-T11n72-125) illustrates interactions that transpired during this activity:

T: This activity involves picture of plants and animals. Lay them out for everyone to see. Take the piece of paper with question and picture of a map. Read quickly together the information about biome in your information sheet.

Look at the map of the South African biomes. Each color is a different biome. Read from the information sheet. Read about description of each biome you have and then decide which biome your pictures belong to. Are your pictures from fynbos, savannah, and so on? You just have to decide which biome your pictures belong to (re-emphasising). Try and decide what biome your pictures represent. Look at your pictures see how humans are benefiting from ecosystems (ecosystem services). Also use these pictures to see how humans impact negatively on the environment. List how humans are benefiting and how man is negatively affecting. Please shout if there's any problem.

L: Let's read guys and explain in our own words or understanding.

They read then translated in their own language

L: Biome is an area where species can survive and are adapted

L: a place for that particular species and are adapted

L: I think guys let's just say it is a place where a group of organisms live and only because they live and adapt to that particular environment and climate.

They agreed on this one and wrote it down

Teacher intervened by reinforcing instructions

T: Once you figure out what the biome is then say what this particular biome you have is . Put this on the top. Then look at the pictures and say which pictures of plants and animals belong to your biome. Then look at the human activities.

The poster was supplied to arrange this information with subheadings. The headings were as follows:

“Our Biome is; Biodiversity in our Biome; Ecosystem services; Human impact”

T: This will help you answer your questions easily

Learners then discussed their assigned biome and pasted pictures that they thought were suitable.

The discussion went as follows:

L: Ours guys is forest no guys lemithi yomile [trees are dry] this picture can't represent the forest biome. The forest biome inethakakhulu (rains a lot) so there should be imithiemininzi (it should be densely populated with vegetation) le ipicturei dry guys [this picture represent a dry area]. Trees should be long guys ixinanekubekhoiforestplants (pictures of trees representing a forest biome should be long and have a dense population of vegetation). Look kuthwaaphakulento [this reads as follows]) some of the plants that grow here are like yellow wood.

Learner picks up a picture of a tree saying is yellow wood

L: No guys this tree is too short can't be yellow wood remember from our Life Science book yellow wood appears to be a tall tree.

L: No guys it may look short in the picture because it's still growing look at this picture there so many of these close (dense) let's take this one.

They all agree

L: Haimna guys mnandiyayidoubtkwale biome siyiselectileyomnakum [I doubt if we have chosen a correct biome] this looks like a fynbos. Let's go to the map and see. Let's go back to the readings guys.

Reading confirms it is forest biome.

Here is another example of a discussion concerning biome identification, this time from another group:

L: Human impact guys. Mining xagugrunjwa (leaner literally translating what mining is) what is it in English? Digging.

L: How is that an impact guys?

L: When you do mining you destroy nutrients of the soil even though they get gold. Soil science guys (referring to agricultural science) and polluting the air or atmosphere that we breath. Iyakulanto (it goes to) do you still remember what teacher Bottoman said in the investigation he gave to us (Physical sciences teacher) lantoyala acid rain eis hcan't explain let's leave it. Ngu Goerge kengoku ingxaki [meaning unable to explain in English]. Bhalasisi [write girl] referring to the scribe not dinging digging mining guys.

L: Look at the pictures with the hides. When we want these hides for our traditional clothes we have to kill these animals. Eishnyhani (its true) the ecosystem will collapse. [realising what effect killing of animals would have on the ecosystem]

T: (Intervenes in the discussion) how does killing affect the ecosystem?

L: Before you get the hide you have to kill so you are destroying what is supposed to live. Kaloku everything that lives on this earth has a reason to live. Some organism as i ecosystem isitshoi definition yayo so some organisms depend on the other so if you kill the organism ithink some organisms will suffer and if those die then the others that were depending on them will not have something to eat then ecosystem will collapse. (Learners are trying to apply their understanding of the definition of the ecosystem in justifying how killing of animals can affect biodiversity).

L: That's true, that's true

The teacher moved around helping learners to rearrange some of the pictures they have placed under subheadings, for example a picture of a bee pollinating was put under biodiversity found in the selected biome. Then the teachers explained the role of bees in the ecosystem through question and answer.

T: What process is illustrated by this bee in this picture?

L: Pollination

T: What else do bees provide?

L: Pollinating and providing honey

T: So guys without bees - without pollinators we are in trouble. We could actually run out of food. It's an important process that enables food production. We need biodiversity so that there

is food. If we remove all the vegetation there will be no food for the bees. They will die out. We also get honey. You guys like honey.

The picture is then put on services instead under biodiversity found on the selected biome.

During these discussion learners switched from English to *IsiXhosa* to explain meanings of certain words they struggled to understand. The learner support material which was supplied appeared to scaffold learner understanding of biodiversity concepts. For example, learners used the reading material to support their decisions in selecting the biome. Pictures were used to represent visual interactions which occur in ecosystems as well as the impact once nature is disturbed. Through use of these pictures and with some help from the teacher, learners were able to identify benefits and impacts in ecosystems. To ensure these ideas were fully grasped, learners were required to present their findings.

These presentations were done in English and were used to share information with each other. This gave the learners an opportunity to practice communicating in their second language, thereby strengthening their communication skills.

During this lesson learners were engaged in a variety of activities representing an assortment of styles of interaction ranging from reading information, analysing pictures and presenting findings. This lesson promoted participation and centred the learners' attention on human impact on the environment. The lesson also showed evidence of peer to peer interactions.

4.5.2 Teacher 1 - Lesson 2

This lesson was a continuation from the previous lesson reinforcing knowledge of ecosystem services and human impact. The lesson relied mostly on a question and answer method where the teacher effectively used knowledge from the previous lesson to build on learners' conceptual knowledge of biodiversity concepts through mind map construction. Questions were asked to provoke retrieval of information. The teacher used the strategy of breaking down compound words to scaffold learner understanding of the vocabulary. The following interactions illustrate how various strategies were used to evaluate learner understanding of biodiversity concepts (OB-T1ln 164-188):

T: I want to find out first how much you know about ecosystem services from what we did last time. Can anyone try in your own words and give the description of what ecosystem services are? Just give an explanation in your own words what ecosystem services is all about.

L: Quiet

T: Ok let's break it down. Ecosystem, what does this mean (teacher writes the concept on the chalk board)?

L: Ecosystem is an area where there is an interaction between living organism and the nonliving.

T: (Emphasises by adding to what the learner has said) Nice and short description so an ecosystem is where there is an interaction between non-living and living interacting with each other in the environment so they are depending on each other for survival. I want us to use the science language we may say the biotic and the abiotic. Abiotic stands for...?

L: Non living

T: Non-living and what kind of non-living things would you find in an environment.

L. Water, air, soil

T: I am not sure if we can put soil in there because soil has got living creatures in it. Soil is full of life but obviously soil is made up of rocks and minerals which are non-living.

T: Ok we have got an ecosystem and we know what it is. What about services? What is a service? What do you understand by the word service? You do not have to explain it in terms of biology. Like if you go to a car wash they are providing you with a service. So how do you describe this word service?

L: If you go to a car wash and then they wash your car they are giving you service they are providing you with what you need.

T: They are providing with what you need I like that. Then can you see from what these two words mean we have an ecosystem that is providing us with what we need.

In the above interaction the teacher used learner prior knowledge in making meaning of the complex term, asking questions to stimulate talk and allow learners to think about these terms. The word was then broken down into its two constituent parts, which provided a structure to

define the term. Interestingly, learners were able to define what an ecosystem is, probably because of the knowledge they had gained in the previous lesson, but struggled to define the word ‘service’ until the teacher provided another structure (the context of the car wash) to help them understand it. In this case, with the teacher’s assistance, the learners were able to relate the ‘service offered by a car wash’ with ‘service’ as it relates to biodiversity.

The lesson was then concluded with a group activity where learners were required to construct a mind map of biodiversity concepts. Each group selected one biodiversity related term in order to define the meaning and comment on how it affects biodiversity. The word ‘biodiversity’ was written in the centre of the chalk board and learners helped to develop a mind map expanding on the main concept. One group, as an example, described alien plants and their invasive nature (OB-T1 ln 64-69).

*L: **Alien** plants are plants that do not grow naturally in that area (learners verify this definition in their textbook). Let’s explain now how these affect **biodiversity**.*

*L: Remember guys’ bekuthwe [it was said] alien plants like pine trees they use a lot of water. They take most of the water that can be used by other plants. If other plants can’t have water they will die then **biodiversity** of **indigenous** plants is decreased.*

*L: Another thing they take all the space and food for other plants in that way they are **invasive**.*

In the interaction above learners seemed to be able to relate the concept of loss of biodiversity with the introduction of alien species. Use of the phrase ‘*biodiversity of indigenous plants*’ suggests that learners understood that the biodiversity of indigenous plant species may be disturbed by the introduction of alien invasive plants. In the discussion above learners volunteered more than two biodiversity related terms. Terms like ‘aliens’, ‘invasive’, ‘indigenous’, and ‘biodiversity’ were used regularly, thus expanding their conceptual knowledge.

4.5.3 Teacher 1 - Lesson 3

This lesson lasted about 30 minutes and was centred on vocabulary building. Learners were provided with sheets of blank paper on which they wrote one word vertically on the page, and then used each letter of the word to build another word relating to biodiversity. Each group selected its own initial term to build their vocabulary.

Figure 6: Illustrating use of chalkboard in guiding learners in the activity on vocabulary building



Figure 7 above illustrates how the teacher used the chalkboard to guide the activity. Each group chose a different term which the teacher wrote it vertically on the chalkboard. The learners then began to brainstorm words that started with letters from the primary word. This activity gave learners an opportunity to suggest as many words relating to the concept as they had learnt, thus building up their vocabulary around the concept of biodiversity. This activity challenged learners to brainstorm, think, write, spell, define and discuss vocabulary relating to the biodiversity concepts they had been exploring in previous lessons.

4.5.4 Teacher 1 - Lesson 4

In this lesson, which focused on contextualising human impact on the environment, learners were required to discuss in groups examples of human impact on the environment relating to their own communities. They were also required to come up with ideas for projects that they could initiate as a response to these issues. Interaction among these learners went as follows:

L: I think the problems we have are these people who sell traditional medicines, also we have so many shacks in our area and people leave rubbish in every space.

L: Are we supposed to look at all these impacts or must we choose one? I think we should take one so that we don't say what other groups have said.

L: Let's take the problem of shacks that we have.

L: Yes when we build shacks we destroy plants.

L: Not only plants guys remember there are animals that depend on these plants for food.

L: What about their place to live?

L: Yes also there is that thing bekuthwe [have said] deforestation is one of the things that lead to global warming. Like if we cut plants to build our shacks there will be fewer plants to reduce carbon dioxide in the air. Carbon dioxide is used during photosynthesis.

L: Okay can hear your point let's say deforestation yandisa [increases] the amount ye carbondioxide then increase of carbon dioxide kubaiyi greenhouse gas iyancedisakwiglobal warming [let's say deforestation contributes to enhanced greenhouse effect].

L: Let's write now solution. Like what can we do?

L: Yho! If you tell people not to build shacks bazakuthisihlalephi [they will say 'where must we stay']?

L: But I think the problem here in our own area even if you are young like you are allowed to have your own shack. People must look at the age first of the person who builds a shack like if you are still young you stay with your parents. I think that will reduce the number of shacks then solve the problem.

L: I think also government must introduce projects ezilalini (in rural areas) so that people don't come and increase numbers here because they leave their homes and come and build shacks here.

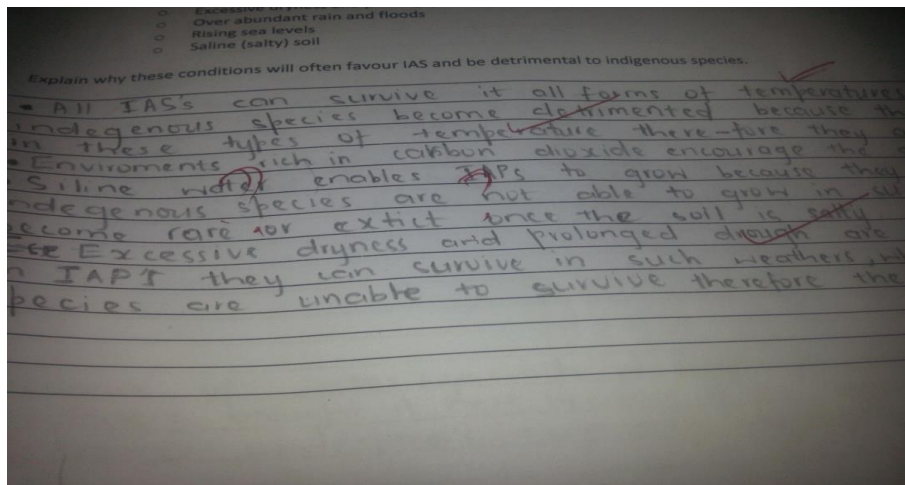
This brainstorming session encouraged learners to think and talk about what is happening in their own communities, bringing the issues discussed in the classroom closer to their own lived experience. While reflecting on their experiences, one group was able to relate housing development to deforestation. This discussion raised local issues such as habitat destruction and degradation of land as well as more global issues like climate change. From these deliberations learners were able to apply the knowledge they acquired of human impact on the environment to their own context.

4.5.5 Teacher 1 – Lesson 5

The last lesson consisted of an evaluation of individual learning through an activity worksheet. Each learner was required to read about invasive alien species - what it was, how it spreads and how it becomes invasive. The worksheet also included a description of the impact of alien invasive species on climate change and ecosystems in South Africa, as well as an excerpt from the local newspaper which reported on the case of a noxious water weed (*Eichhorniacrassipes*) that had choked a local river (Daily Dispatch 15/02/11). This worksheet required learners to interact with this information when responding to the questions. This information was used to support learners in answering these questions.

The worksheet assessed a range of cognitive skills ranging from lower order questions to higher order questions. These activities, for example, required learners to respond to questions giving examples of both intentional and accidental introduction of alien plants, compare species of alien plants, describe how they become invasive, explain what impacts they have and how similar or different such impacts are. Learners were also required to explain how changes in climatic conditions often favour invasive alien species over indigenous plants. From the sample of learners work analysed it was observed that although some learners were able to respond to 'how' and 'why' questions which required them to express themselves, the extent to which they were able to engage with these questions was limited. For example, in responding to a question which required the learner to explain how changes in climatic conditions will often favour invasive alien plants (IAP), one learner responded as follows:

Figure 7: Illustrating learners' response

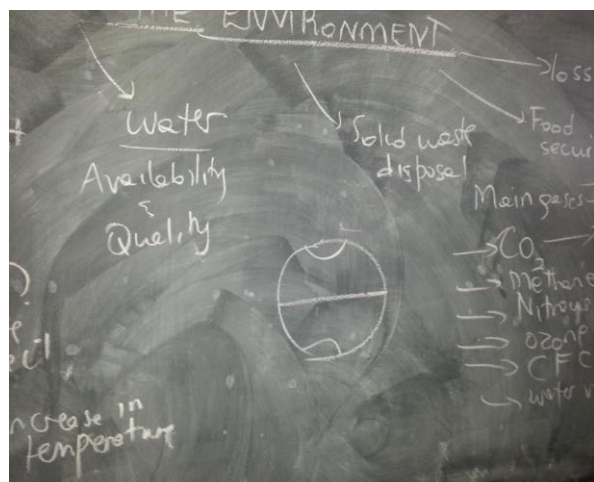


This learner seemed to be able to compare the adaptive features of alien plants and the inability of indigenous plants to adapt to unfavorable climatic conditions as a cause for their survival. However, gaps in this response include the lack of explanation for the structural features and specific traits alien plants exhibit (like extensive root systems enabling them to reach the water table), giving them an advantage over indigenous plants.

4.5.6 Teacher 2 – Lesson 1

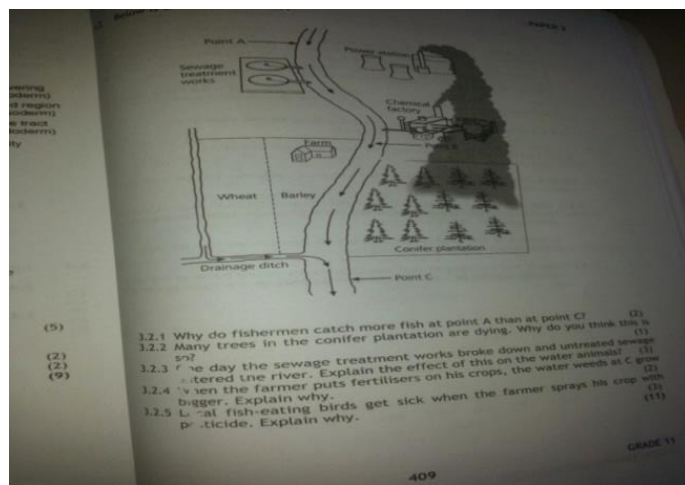
The teacher introduced the lesson by listing a variety of activities that occur in learners' communities and encouraged learners to reflect on these through a question and answer method. The teacher used learners' prior knowledge to elicit responses and referred to the context of the learners while discussing these activities and their impact on the environment. The question and answer method was continually used to further engage learners further. The teacher then listed on the chalk board all the terms relating to human impact on the environment, describing what each term meant and explaining its relation to biodiversity. Learners were required to deconstruct terms and provide meanings. For example, when learners were unable to describe what a pesticide was the teacher reduced the word into parts - 'pest' (organism that harms your crops), and 'cide' (kill). Together with the learners a mind map was drawn on the chalk board illustrating the human impact on the environment looking at the causes and effects. Figure 9 (below) illustrates how the chalkboard was used to summarise important aspects of the lesson.

Figure 8: Illustrating use of chalkboard summarising important aspects of the lesson through a mind map



The lesson concluded with an activity from learners' text books (409), where the learners were divided into groups of five. The activity presented a map of a river running through a developed area (point A) including a power station, sewage treatment works and a chemical factory. At point B were farms and a conifer plantation. At point C a drainage ditch flows into the river, as illustrated below.

Figure 9: Illustrating case of the river represented by pictures



This case was presented in the form of labeled diagrams and pictures as illustrated above. Before answering the questions, learners were required to identify human activities along the river and to explain how each one affected the river ecosystem. This scaffolding activity was purposefully adapted to prepare learners to answer applied questions about the case. The pictures introduced a

visual context to the exercise, allowing learners to connect the human activities with the ways in which they impacted the river, allowing learners to make meaning through the process. By including a scaffolding exercise, the learners were provided with a base to begin answering the questions. The interaction went as follows (OB-T2 ln30-67):

L: Look there is a farm (pointing at the farm house) the farmer has planted wheat and barley.

L: Okay how is this then affecting the environment (reflexive question from the learner)?

L: I think, when they plant them they first prepare the soil by removing the plants that grow there and plant their own and what do we refer to this process of removing plants that grow there (linking the act of tilling the soil with deforestation)?

L: Deforestation

L: But I don't think that is an effect because they are growing some plants now the difference is that these ones are for them to eat like iwheat ingqolowa for isonka guys (learner here seems to justify deforestation by replanting of a different kind of a plant in the area)

L: But what about the plants that were growing there nenkawu mhlaumbizihlalaapha (habitat of animals) (reflecting on how planting might have destroyed habitats of other organisms)?

L: What do we say to organisms that naturally grow in that particular area?

L: Indigenous

L: Are you trying to say wheat is not indigenous?

L: I am not sure but I think so all I know it is planted so it means there were some plants growing here before so le farmimngidisturbei living place zezinyeiorganisms (destroyed habitat of other organisms). Like ayahlukangakulemithiilaphaecaleni (it does not differ from the trees alongside) look it say here conifer plantation eligamalisuka [this word is derived from] from planting ityaliwebethuna (it's planted) did not grow there naturally (comparing planting of wheat to planting of conifer).

L: People this is different ingqolowakudalayabakho (wheat has been here for ages)

L: Hai I am not happy. Lets call the teacher (teacher is called)

L: Siyaphikisanaabanyebathi (we disagree some say) iplanting of wheat disturbs indigenous plant as if wheat is not indigenous

T: Ok what is the matter? You don't agree how wheat has arrived in this place or conifer?

L: No sir we understand the plantation but wheat we don't understand how it is not indigenous? Like if they were referring to effects maybe like use of fertilizers which can affect the river I will understand.

T: Ok let's see. How has wheat arrived in this farm?

L: It was planted

T: It means it has been brought into this place

L: If something is not growing naturally in that area what do we refer to that organism

L: Alien

T: Would you describe then wheat as alien or indigenous?

L: Alien

During this interaction learners were allowed to switch from English to mother tongue. This appeared to have enabled a free and a relaxed atmosphere to facilitate discussion. The teacher used reflexive questions to support the learners in arriving at an answer. When learners could not decide, for example, whether wheat was indigenous or alien, instead of providing a direct answer, he used questions that forced the learner to think about how the wheat had arrived in the area and used learners' previous knowledge of the definition of alien and indigenous plants to guide their thinking. Learners used the terminology that they had learnt while analysing this case. Even though this was not a terminology exercise, terms like deforestation, alien and indigenous were used to explain certain processes.

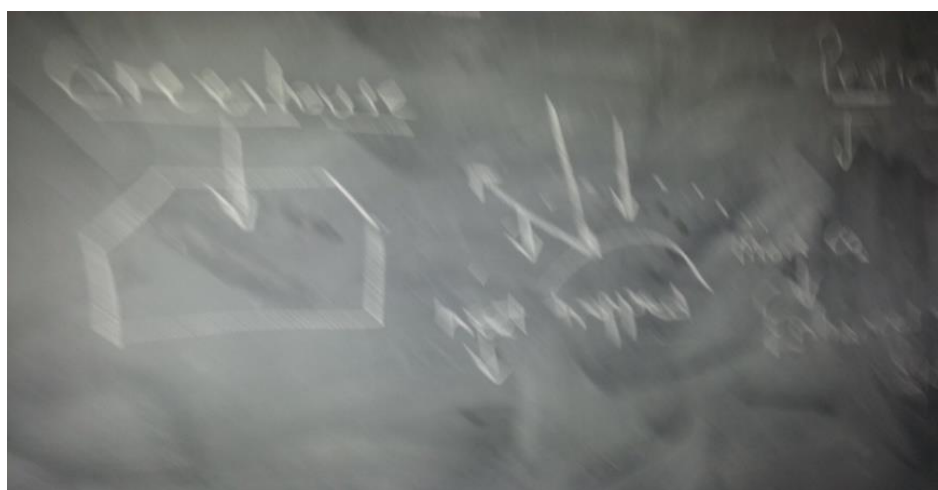
4.5.6 Teacher 2 -Lesson 2

This lesson was based on the effect of greenhouse gases on climate change and their impact on biodiversity. The teacher tried to explain the greenhouse effect by relating it to the green houses used by farmers to grow plants that cannot withstand cold conditions. The analogy of a greenhouse was used to enable learners to make meaning of how greenhouse effect occurs. The

teacher also used information from the previous lesson to explain the effect of deforestation and other human activities like burning of fossil fuels which contribute to accumulation of carbon dioxide in the air. Amounts of relative contribution and sources of the main air pollutants that contribute to greenhouse effect were discussed.

The chalkboard was used while distinguishing between the greenhouse effect and an enhanced greenhouse effect using diagrams of both the analogy of a greenhouse on a farm and the diagram illustrating the effect of greenhouse gases on earth.

Figure 10: Illustrating use of chalkboard to distinguish related terms (greenhouse effect and enhanced greenhouse)



The diagram of the house (above) was used to explain how greenhouses operate, and this was compared with the other diagram alongside to explain the concept of greenhouse effect and enhanced greenhouse effect. Most of the information was provided by the teacher explaining the process with little written on the chalkboard. The chalkboard summary only represented a skeleton of this process as shown above. The lesson was then wrapped up with the teacher giving a description of terms and the learners identifying those terms. Learners responded by chorus answers. Homework was given on page 339 of their textbooks. The teacher went through each question explaining what the question required. Questions were mostly low order as they focused on listing, defining and describing global warming and its effects.

4.5.7 Teacher 2 – Lesson 3

During this lesson, learners were organised into groups and required to debate how human activities contribute negatively to the environment. One group was in support of human activities and their benefits, while the other group argued against these activities looking at their impact. It was interesting to see how learners were able to justify their views on this topic. The teacher consolidated the debate by pointing out together with the learners some services offered by nature and how over-utilisation of these can affect biodiversity. At the conclusion of the lesson, learners were required to list sustainable practices that could minimise the impact.

4.6 Presentation of data from post observation interviews

These interviews were conducted to reflect on teachers' pedagogy and reasons for choosing one strategy over the other. It was difficult to conduct these interviews immediately after each lesson as teachers had other commitments they had to attend to. We rescheduled the interviews for immediately after the last lesson.

4.6.1 Teacher 1- Interview 2

The interview started off with the teacher reflecting on her choice of pedagogy and reasons for choosing one strategy over another as well as looking at the challenges encountered during the lessons. During the lessons group work and group presentation was the predominant activity. Upon reflection, the teacher indicated that group work was the most reliable strategy to manage the big numbers in her class.

Group work was also intentionally used to stimulate talk among learners creating a favourable atmosphere where learners were free to use any language they were comfortable with in their discussions. However, she emphasised that presentations were in the language of instruction specifically to encourage learners to practice the language of instruction. When asked about the purpose of permitting learners to switch from English to home language she responded (in her own words):

I think it's because it stimulated discussions among learners and allowed them to start exploring the concept maybe in their own language even though they will have to discuss in English but not

always. I gave them a space to discuss in a safe way. Instead of being asked questions and be put on a spot.

I know from my own experience of being a learner I never gained much when somebody talks all the time I would lose my concentration in about five minutes. I think the approach is facilitation rather than lecture style you just give them tools they need to access knowledge. I was just creating an unthreatening space where learners can talk about in their own language and they can still learn without the communication barrier (Int2-T1-In58-66).

Reflecting on how these group activities were dominated by some learners, the teacher indicated that she was aware that in most cases particular learners were more vocal during discussions and presentations even though the Learner Support Materials that she used encouraged everyone to be fully involved in the lesson. The teacher did, however, note an opportunity for improvement as she indicated that learner dominance could be minimised by structuring activities in such a way as to give each learner an opportunity to report during presentations.

When watching the filmed lessons with the teacher it was obvious that she had anticipated learners' challenges in understanding biodiversity concepts, since she purposefully included a range of scaffolding strategies to assist learners in understanding complex concepts. However, in another instance teacher 1 noticed that she had assumed that certain teaching strategies would work well without having evaluated them. In this particular instance, the teacher had used the example of a tree to explain resilience in an ecosystem, assuming that the learners understood the concept. Later, the teacher realised that she could have asked learners to provide examples of kinds of resilience in the ecosystem to check if the concept was really understood.

4.6.2 Teacher 2 – Interview 2

This interview also started by the teacher reflecting on his practice during the lesson. The teacher seemed to be confident that the lesson went well and that his choices of strategies were successful in every respect. We then watched the recording of the lesson together, and were able to identify some of the opportunities the teacher may have missed during the lesson, specifically a lack of detail in the chalkboard summary. The teacher realised that he had only written key words instead of the full description of the terms under discussion. For example when learners

came across a new term he asked for a definition or explanation but neglected to write out the definition for other learners to read and copy into their workbooks.

We also discussed his drawing of the green house during this interview. The drawing of a green house that was used to compare and contextualise the concept of greenhouse effect was merely a skeleton supported by a verbal explanation. The teacher neglected to add detail to the drawing distinguishing it from any other regular house. In the interview, teacher 2 realised that should a learner want to refer to his/her notes later on, he/she may struggle to find the connecting concepts as there were no supporting notes provided at the time. The teacher then noted opportunities for improvement and suggested that he could have added greater visual detail to his diagram and remarked that a summary of written notes may also help learners to a greater extent. The conversation below presents the teachers response during this interview (Int 2-T2-ln60-74);

R: You used this drawing of a greenhouse to explain the greenhouse effect which I found it relevant for this concept but looking at the drawing does not seem to have relationship with concept don't you think this could be confusing?

T2: No when I explained the concept I started by explaining how the greenhouse works then constantly related to how greenhouse effect happens and later on explained enhanced greenhouse effect.

R: Yes that is true I also observed that but what I am trying to drive at how will this drawing maybe try and help a learner who has not understood the concept when you were explaining. Let's say the learner is trying to remind himself of what was taught in class at a later stage

T2: Ok in that case it could be a problem. I think I should have labeled the drawing maybe put some plants inside and show the direction of the sun entering the house and how it is trapped. Maybe it was just a slip from my side. Maybe give them some written notes on this.

We also noticed that during the word activity he allowed learners to respond in chorus-like format instead of allowing learners to respond individually. The teacher realised that this method may lead to an assumption that all learners are at the same level of understanding while in reality some may be left behind.

In some cases the teacher failed to correct misconceptions. For example, during the debate some learners mentioned greenhouse gases like carbon dioxide as a direct cause of ozone depletion. When we discussed this issue it seemed as if the teacher was convinced that the learners were right. When we looked at the effects of ozone depletion he realized that learners should have indicated that once ozone layer is depleted less ultra violet rays are absorbed resulting in more ultraviolet radiation reaching the earth. This can destroy the photosynthesizing plants resulting to less food being produced, decrease in oxygen levels and increase in carbon dioxide levels which will affect global warming.

We also noted in the last lesson the teacher continued with the lesson without referring back to the home work prescribed for the previous day. The homework related directly to the discussions in the lesson and it was acknowledged that if the homework had been included as part of these discussions, some of the potential misconceptions would have highlighted and dealt with and learning opportunities would not have been missed.

4.5 Concluding remarks

In this chapter evidence was presented which illustrated data from various sources such as interviews, observations and documents as described in chapter 3. This data was presented to take the reader through my research journey and to see what emerged during the data analysis.

Data from policy documents enabled me to determine curriculum expectations of the content to be covered as well as explicit and implicit strategies to be used when teaching biodiversity. This data also revealed interconnectedness between topics within the grade as well as across the grade and assessment guidelines. This formed the basis of what guides the choice of strategies used by educators mediating biodiversity concepts. CAPS as a guiding policy should have an influence on the selection of teaching strategies. This partly enabled me to answer my research question which seeks to understand how Grade 11 educators mediated biodiversity concepts with English second language learners.

In answering my sub-question, “What are the Grade 11 Life Science teachers’ experiences and views on learners’ challenges who are English second language speakers in understanding biodiversity concepts”, data gathered from interviews indicated some of the enabling/disabling

factors in making meaning of biodiversity concepts with second language learners. Teachers indicated a range of challenges experienced by learners when making meaning of biodiversity concepts including spelling problems, inability to interpret questions, complexity of biodiversity as a concept, and failure to make connections as discussed in Section 4.4 above.

It appeared that teachers, informed by their experiences of learner challenges, used various scaffolding strategies to support learners in making meaning of biodiversity concepts. These were from suggested and actual strategies used to make meaning of biodiversity concepts as presented in Sections 4.4 and 4.5 above. Insights from suggested and actual strategies that teachers employ when assisting learners enabled me to answer sub-question 2, “What pedagogies and strategies are used by Grade11 Life Sciences teachers assisting second language learners to make meaning of scientific concepts in Life Sciences?”

From the lessons observed learners were engaged in various activities which enabled learners to interact with one another, with the teacher and with the activity itself. These interactions were used to create opportunities for learning. During these activities learners were supported through the use of a variety of worksheets and teaching aids which assisted learners in making meaning of biodiversity concepts. During interactions with these learning aids learners were allowed to use their mother tongue to intermingle and merge language with thinking, creating opportunities for learning.

Data from my observations also revealed the types of quality scaffolding complementing what was suggested during interviews in some cases. It appeared that teachers were guided by their experiences as well as the challenges they often encounter in their teaching to include certain strategies that to assist learners in making meaning of biodiversity concepts. This, together with other insights emerging from this data, will be discussed in the next chapter.

Chapter 5: Interpretation and discussion of findings

5.1 Introduction

In this chapter I discuss insights on mediation of biodiversity concepts by grade 11 teachers with English second language learners. Discussions in this chapter are drawn from data presented in Chapter 4. These discussions are substantiated with extracts from the data presented in Chapter 4 and guided by literature reviewed in Chapter 2. The discussions are further guided by the research questions I wanted to answer during this study.

In line with the goals and objectives of the study, five analytical statements are discussed from which concluding remarks will be made. Analytical statements are categorised according to: the teachers' experiences of challenges experienced by learners when making meaning of biodiversity concepts; teaching strategies used by teachers to assist learners; nature of teaching strategies employed; challenges experienced by teachers when implementing these strategies; as well as feedback on reflections of teachers in their choice of strategies.

The following Analytical Statements were inductively derived from my data:

Analytical Statement 1: Factors that limit learner understanding of biodiversity concepts are a result of a variety of contributing factors.

Analytical Statement 2: Teachers demonstrated knowledge of a variety of teaching strategies to support learners.

Analytical Statement 3: Strategies used were mostly learner centered.

Analytical Statement 4: Challenges experienced by teachers when making meaning of biodiversity concepts indicated similar origins.

Analytical Statement 5: Teachers' reflections on their practice provided opportunities for teachers to identify strengths and limitations of their choice of strategies and possibilities for improvement.

I now discuss each of these Analytical Statements in detail below:

5.2 Analytical Statement 1: Factors that limit learner understanding of biodiversity concepts are a result of a variety of contributing factors

Section 4.4 presented data from teachers' views and experiences of learners' challenges in making meaning of biodiversity concepts responding to sub-question 1. Teachers indicated a number of factors which limit learner understanding of biodiversity concepts. It appeared that there are a variety of factors which limit learner understanding of biodiversity concepts. These ranged from learners having spelling problems, learner inability to interpret data response questions, as well as the complexity of biodiversity concepts with interrelated terms (Int1T1, T2). For example, both teachers indicated that learners made spelling mistakes which alter the meaning of the word and thus disadvantaged such learners during assessment.

Teachers claimed that this often happens when students are confronted with terms that sound similar. Students tend to fail to distinguish between such terms. A leg/lag phase mentioned in Section 4.4 is just one example of such cases. In this regard, the teachers' arguments are consistent with Examiners' Reports (2009-2013) which repeatedly pointed out learners' spelling problems, lack of interpretation and analytical skills which resulted in them giving irrelevant information that is not worth awarding marks (see also Section 1.3.2.1). Echoing similar sentiments Nakale (2012) argues that language errors like these lead to misconceptions. Kocakulah, et al. (2005) point out that lack of grammar, lack of understanding of rules of syntax as well as a lack of comprehension in meaning of words in different contexts puts second language speakers at a disadvantage, being less able to see meaning in text.

5.3 Analytical Statement 2: Teachers demonstrated knowledge of a variety of teaching methods and strategies to support learners

In answering sub-question 2 which required knowing what pedagogies and strategies are used by Grade 11 teachers in assisting second language learners to make meaning of scientific concepts in Life Sciences, data presented in Section 4.4 helped in this regard. Data revealed some of the teaching strategies that the teachers claim to use to help second language learners to make meaning of biodiversity concepts (In1T1, T2). For example, teachers claimed to break down compound terms to simplify meaning of these terms, use learner context to enable learners to

relate to meaning of concepts, and chalkboard summary to write correct spelling of words, to mention but a few strategies.

These claims were evident during the lesson observations as presented in Section 4.5. The varied nature of the strategies selected by both teachers demonstrated teachers' thorough knowledge of various teaching strategies. The study also revealed that teachers had specific reasons for using different strategies to assist learners, based on the need to cater for various learning preferences. Furthermore, their experiences of the challenges experienced by second language learners in making meaning of biological concepts also influenced their choice of strategies. For example, in an attempt to help learners to spell words correctly, teachers in this study viewed use of the chalkboard to write and allow learners to copy correct spellings as helpful. They further suggested that this strategy assists learners in reading while copying and writing at the same time.

Shulman (1987) regards the choice of teaching strategies as not just "picking any teaching strategy from a bag of teaching tricks" but as a reasoned pedagogical choice which he claims as foundational to PCK. However, Shulman emphasizes a combination of pedagogical knowledge and knowledge of content as the balance that shapes knowledge construction and ensures better understanding of the content.

In this study, the two teachers suggested a number of teaching strategies that can be used to assist learners such as use of prior knowledge to elicit response, breaking down of compound terms to simplify complex terms, and use of learner context to make meaning of biodiversity concepts. During an activity where learners were required to define the meaning of ecosystem services, when learners were unable to provide the meaning the teacher suggested that they break the word into its simpler parts, using this strategy to simplify the seemingly complex term. Learners were only able to define what an ecosystem was using their prior knowledge but struggled to define a service. It was interesting to see how the teacher guided learner response by giving an example of a car wash for learners to relate to their preexisting knowledge (using what the learner is familiar with triggering prior knowledge). The idea of a car wash was used as a supporting structure which allowed for the best explanation to emerge.

Questioning appeared to have prompted the learner to express himself more accurately. The teacher stated, *“If you go to a car wash they provide you with a service. What is a service?”* This kind of questioning seemed to provoke retrieval of information as the learner responded by saying, *“If you go to a car wash.... they are providing you with what you need.”* The learner in this case used the teachers’ wording in the question as a model and expanded on it by giving meaning to the word ‘service’ relating it to a service of a car wash (Tharp & Garlimore, 1988). This is just one of many examples which indicate a combination of different methods and strategies used to assist a learner to make meaning of a complex term. Use of a combination of strategies and methods to scaffold learner understanding of the seemingly complex term may be attributed to knowledge of the content as well as pedagogy as suggested by Shulman.

5.4 Analytical Statement 3: The Strategies used by teachers were mostly learner centered

The strategies used by the teachers during my observation were mostly learner centred, and they varied in style and the extent to which they involved the learner. The activities provided the learners with opportunities to participate in the learning process thus assisting them in developing skills of co-operating, listening, responding and negotiation. What follows is a discussion on some of these activities.

5.4.1 Visual and mental representation of context to make meaning of concepts

In some of the activities given, teachers supplied learners with pictures representing human activities to allow them to relate to the context of environmental issues. Learners were required to interact with and analyse these pictures which conveyed clear images of environmental issues, and which supported the learners in the process of identifying the issues at hand. The pictures displayed localised environmental issues that learners can relate, creating opportunities for discussion. Lotz-Sisitka and Russo (2003) argue that picture based materials could be useful in overcoming language barriers as they provide a visual rather than a vocabulary based text. Lotz-Sisitka and Russo posit that use of picture based materials provides a more accessible medium which enables learners to gain confidence in articulating their ideas without having to interact with written text.

Reflecting on use of this strategy, T1 demonstrated understanding of the effectiveness of this strategy: *“I think the pictures were there to kind of contextualise the key terms. I tried to choose them intentionally representing the Eastern Cape context to try give them something that they can relate to (Int2T1)”*. Through this practice, the teacher intentionally introduced an element of familiarity in the lesson, with the aim of creating opportunities for learners to construct new knowledge using their preexisting knowledge as a foundation for learning. T1 also noted, *“The pictures also became a stimulus to spark the discussion within the group and which is also another way of getting them to describe what they see in the pictures and also it has implications of the language finding their own language to describe what they see i.e. using Xhosa so that they don’t get stuck with difficult definitions (Int2T1)”*.

From the above conversation it appears that the teacher intentionally used these pictures to provide learners with a point of reference. This seemed to provide learners with opportunities to actively engage with the task at hand by describing what they see, stimulating further discussion. O’Donoghue, et al. (2007) describes such teaching methods as delivering far more than subject based information, as they bring meaningful knowledge of the world into the classroom. Stevenson (2013) argues that approaches to curriculum and instruction that acknowledge the places where students live become a basis upon which learning is constructed and that when teachers do this, students more easily understand why they are learning what is being taught. Learners learn as they engage in shared activities and conversation with other learners (Walqui, 2006). As they engage in reflective discourses with others students they build the language that they need to take their learning further.

Learners were not only given picture based activities but were also supplied with reading material which gave learners an opportunity to read about the environmental issues related to loss of biodiversity. Data presented in Section 4.5 (lessons 1 and 5) revealed that the information provided in these readings was localised to the South African context, which enabled learners to familiarise themselves with local issues as well as the language they are required to learn. As they read they became familiar with a network of word meanings which in turn supported them in finding the correct answers to questions posed. As an example, when learners were uncertain as to their interpretation of the pictures provided in identifying a particular biome, they referred to the readings to verify their answer. O’Donoghue, et al. (2007) argue that reading texts on new

topics is key to knowledge acquisition necessary for engagement in further relevant learning. He claims that reading about these issues may help learners to find good quality information concerning the environment and environmental issues that could enable them to make informed decisions on how to respond to environmental challenges.

5.4.2 Engagement of learners in group activities and presentations influenced discussions for joint knowledge construction

Most of the activities that were given to learners, especially those in school 1, were group work activities. Collaborative group work was found to provide structured opportunities for developing English proficiency in the context of authentic communication about science knowledge (Vorster, 2008). During these group discussions, however, there was evident use of mother tongue, with learners switching from English to *isiXhosa*. This learning environment seemed to encourage a greater level of conversational interactions which opened opportunities for learners to reflect on the environmental issues and give meaning to how human activities relate to impacts like loss of biodiversity in the environment (see Section 4.5). Grouping of these learners also created opportunities for learning from one another and for assisting each other, creating zones of proximal development (Vygotsky, 1978). Donato (1994) refers to this as collective scaffolding. He claims that working in groups can produce better results than when students work on their own.

The teacher's role during these activities was that of a facilitator enabling sharing during these activities. In the activity on vocabulary building (OB-T1) learners were required to come up with one term that they had studied on biodiversity and use letters of that term to build biodiversity vocabulary. In this situation the teacher transferred the responsibility for the task to students (Walqui, 2006). The vocabulary they had already learnt provided structure for them to build on and subsequently learners actively participated by providing information. Tharp and Garlmore (1988) argue that such behaviour could never occur automatically but only happens with the assistance of the teacher. Tharp and Garlmore refer to this as *assisted performance*.

This activity challenged learners not just to brainstorm a list of words but also required them to define the meanings, as well as how these words relate to biodiversity, thus creating opportunities for dialogue. The ability of learners to come up with meanings for these terms and

relate them to biodiversity indicated their level of independent competence as a result of the scaffolding experience.

Vygotsky (1978) considers learning that stretches the mind of the learner as useful. Some learners in this particular lesson went the extra mile and created a sentence instead of a list of words, which was another indication of the learners being able to think and act beyond their level of development (see Section 4.5). For Vygotsky (1978), the difference between assisted performance as indicated by Tharp and Garlmore (1988) and unassisted performance indicates the zone of development and learning. This is what Vygotsky calls the zone of proximal development. Teachers worked with learners in ways that supported them and challenged them to work independently.

As much as there was clear evidence of interactions between learners during the group work, there were also dominant learners who emerged in group discussions. It appeared that learners who voiced strong opinions during the discussions were the same ones who volunteered to present their work during the feedback session. This demonstrates the limitation of group work in this regard. Even though teachers appeared to have noticed what was happening, not much was done to minimise this. Doff (1988) argues that the danger of group work is that learners of mixed abilities working together often results in weaker students being dominated by stronger students. In such cases, weaker students ‘switch off’ and chances of learning become reduced. Doff suggests that students of similar abilities be grouped together, and that this will help the teacher more easily identify learners who need help, at which point the teacher can offer individual attention.

5.4.3 Probing to guide and stimulate learner contribution

In eliciting learner response, teachers often used follow up questions which guided learners. These questions were of a prompting nature, which seemed to trigger students’ thinking and help them to respond more actively. For example, in an activity where learners were arguing whether wheat was an alien or indigenous plant, instead of answering directly the teacher guided their thinking through using a series of follow up questions (OB-T2, ln30-67):

T: Ok let’s see. How has wheat arrived in this farm?

L: It was planted

T: It means it has been brought into this place

T: If something is not growing naturally in that area what do we refer to that organism?

L: Alien

T: Would you describe then wheat as alien or indigenous?

L: Alien

During this activity learners had to think about the meaning of the term ‘alien’ comparing it with the meaning of ‘indigenous’ to decide whether wheat was indigenous or alien. The teacher in this case guided the learner by using rhetorical questions, paraphrasing student ideas, and differentiating between ideas to validate the learner’s idea.

Scott (2008) suggests that this form of intervention can be seen as the teacher providing assistance that marks the significance of learner knowledge in joint meaning making. Echoing similar sentiments, Edwards and Mercer (1987) note that cued elicitation includes learners into what becomes shared discourse with the teacher. According to Edwards and Mercer (1987), this can be interpreted as scaffolding in the ZPD as it requires learners to be actively involved in shared meaning making rather than merely sitting and listening. However, they also note that this becomes problematic where learners enter into a guessing game while trying to figure out what the teacher wants them to say.

5.4.4 Code switching allowed within groups of learners only

During the group discussions, code switching was permitted, and learners were free to discuss the activities in their first language (*isiXhosa*). Use of *isiXhosa* appeared to have an influence in stimulating a lot of discussion among learners, including arguments, disagreements, finding solutions, shared reading and asking for help. Webb and Webb (2008) view code switching as a communicative resource that enables the accomplishment of educational objectives as it promotes spontaneous reactive discussions and an ability to think more analytically.

In Section 4.5 (lesson 1) an activity is described where learners were required to use pictures to identify a particular biome. During the group work, learners argued that the picture did not appear to represent the forest biome they had chosen, noting that the vegetation was very dry

(4OB-T11nt 104-110). In this conversation the learner referred to information from the picture to describe its context, while comparing it to what he thought a forest biome should look like. This learner could not understand how a forest biome with dense vegetation could be represented by a picture with dry vegetation. He was able to identify that a forest characterised by a rainy climate is supposed to have dense vegetation due to the availability of water essential for plant growth. The learner's use of *isiXhosa* during this discussion centred on him providing reasons for his disagreement with the group's identification of the biome under question. Code-switching in this case seemed to have provided opportunities for this learner to think more analytically.

Learners were encouraged to use their first language in group discussions only, however, and were required to use English when reporting on their findings. This seemed to be intentional on the part of the teacher, in order to create an environment that promotes both the use of the learners' mother tongue while at the same time allowing opportunity to practice speaking English in the classroom context.

5.4.5 Use of prior knowledge to make links between forms of knowledge

The teachers in this study demonstrated various ways of using learners' prior knowledge to mediate learning. In some cases they asked questions which required learners to call to mind knowledge from previous lessons and grades, as well as knowledge from their own experiences as a foundation on which to build new knowledge. These questions were either employed in the introduction of the lesson or during the lesson. For example, in Section 4.5 (lesson 1), the teacher started by finding out if learners knew the meaning of biodiversity. This concept is dealt with in Grade 10. Use of prior knowledge in this context created a climate for participation and contribution. O'Donoghue, et al. (2007) regard an approach that emphasises the importance of basing learning on what learners already know as a learner centered approach to teaching and learning. The example discussed in Section 5.3 above is just one example of where learners were required to call on prior knowledge to make meaningful links to new concepts being introduced.

In this case above learners were able to define an ecosystem using the knowledge from the previous lesson, as well as from their grade 10 work. When they were unable to describe a 'service', the teacher used the example of a car wash service to elicit responses. Again, learners

were able to relate their existing knowledge (car wash service) to the concept of ‘service’ within an ecosystem. Prior knowledge provided a structure upon which to build new knowledge as they extended this knowledge to ecosystem services. UNESCO (2004) regards use of prior knowledge as a way of auditing students’ background experience of a concept about to be taught. UNESCO claims that this provides teachers with information on what learners already know prior to the lesson, which can enable the teacher to adapt the lesson accordingly. O’Donoghue, et al. (2007) maintain that such knowledge lays appropriate foundations for learning, and argues that the role of this information is to ensure that learning expands beyond what the learners already know.

In one of the lessons I observed, pictures of animal and plant life were used to identify South African Biomes (see Section 4.5, lesson 1). Some of the pictures relating to human impact on the environment were familiar to the learners, and seemed to trigger existing knowledge which they brought into a discussion on human activities and impact on the environment. Such activities appeared to assist in contextualising learning within learners’ local experience.

Data presented in Section 4.4 revealed that teachers value making use of prior knowledge in order to form connections between concepts and progression of content within grades. Constructivist theories of learning recognise learners as bringing their own contributions to learning interactions, and view this knowledge as a foundation upon which new knowledge can be built.

5.4.6 Use of mind maps to show conceptual connections

Both teachers used mind maps to illustrate connections between concepts taught. These were used as a teaching, learning and assessment tool. Teacher 1 used mind maps to assess work done in the previous lesson, to support learners in exploring connections between biodiversity concepts, and to illustrate the effects of human impact on biodiversity. Learners were required to construct this mind map on the chalkboard, which became a network of ideas as the learners made sense of the ways in which human activities are connected to loss of biodiversity. From time to time, the teacher reinforced learners’ contributions expanded on current knowledge or addressed some misconceptions. Use of a mind map in this case appeared to provide a means of reviewing and consolidating existing knowledge.

T2 also used a mind map as a teaching tool to explain links between various forms of human impact on the environment and how they relate to loss of biodiversity. This mind map formed a summary of his explanations. Both teachers seemed to use concept maps for a particular reason, with a particular purpose - to make connections between concepts or to review and consolidate existing knowledge. Shulman (1986) views concept maps as a powerful tool for organising and representing knowledge. He argues that when concept maps are used for a specific pedagogical reason they offer ways of seeing into PCK that illustrate how PCK extends beyond knowledge of content or pedagogy alone. The different ways in which concept maps were used, as discussed above, offers possibilities for examining reasons underpinning such practices.

5.5 Challenges experienced by teachers when making meaning of biodiversity concepts indicated similar origins

Through interviews and classroom observation some challenges that educators experience within their practice were revealed. This data enabled me to answer sub-question 3: What challenges (if any) do Grade 11 teachers experience when assisting their learners to make meaning of biological concepts in biodiversity. These challenges are discussed below:

5.5.1 Large class sizes impact the effectiveness of mediating strategies

Both teachers seemed to have considerably large classes, with the number of learners in school 1 being twice the normal size of the average class. These large classes posed various challenges to effective classroom management (see Section 4.4). Even though teacher 1 used group work to overcome this challenge fairly effectively, there were still some problems in this regard. During group work activities stronger learners dominated discussions, and it was difficult for teachers to monitor individual progress as the teacher relied mostly on group assessment, which cannot give a true reflection of the progress of the individual. It concerned me that teachers, due to their significant marking load, allowed learners to mark their own work, indicating that the teachers themselves only mark formal assessments (see Section 4.4). This, in my opinion, could delay the delivery of support that may result from formative assessment. Formative assessment would minimise challenges which are often only picked up at a later stage.

In research on challenges associated with large class sizes, Hess (2001) found that due to large class sizes teachers struggle to: enforce discipline; satisfy all needs of learners who have different interests, personalities and capabilities; organise efficient activities due to time and space constraints; and give timely effective feedback and evaluation.

5.5.2 Chalkboard summary is used to a limited extent to support learning

Observations from lessons of both teachers revealed minimal use of the chalkboard during their teaching. Even though both teachers indicated that they used a chalkboard to write out the correct spelling of words and summaries, it appeared that teachers only used the chalkboard to write key words or illustrate their explanations through mind maps. Most of the explanation was verbal and little was written on the chalkboard to support what they were saying, thus limiting the kind of support that could be offered to learners through comprehensive notes when studying on their own. This was mostly reflected in the conversation with Teacher 2 where he realised that his drawing of the greenhouse to explain the concept of greenhouse effect lacked some important detail that could support understanding of the concept when the learner refers to it at a later stage (see Section 4.6).

5.5.3 Knowledge gap that may influence misconceptions when teaching

During interviews there was an indication that the teachers participating in the study had somewhat limited knowledge and confidence in teaching this knowledge area. Rather than being explicit this was revealed rather through hesitancy in the teachers' responses to certain questions. In the data presented in Section 4.4, Teacher 1 indicated that initially she was scared to teach biological evolution as she had not been taught this subject in her own teacher training. Her lack of knowledge led to a lack of confidence in this subject area. However, through professional development opportunities it was evident that her teaching and knowledge capacity had been increased and along with that, her confidence levels.

Teacher 2 also indicated a lack of confidence when he started teaching evolution and environmental issues, until workshops on this topic were conducted in the district. He refers to himself in the interviews as, *“being not confident at all when started teaching these issues”* and being *“not sure”* indicating knowledge gaps in this subject area. This was evident when the teacher missed an opportunity to correct a learner when he mistakenly referred to carbon dioxide

as a cause of ozone depletion. It emerged during our discussion that the teacher's own knowledge of the causes of ozone depletion, and knowledge of greenhouse gases was somewhat lacking, and that his negligence in correcting learner's misconceptions at that point in the lesson was due to his own knowledge gap in this area.

Songqwaru (2012) claims that teachers have content gaps in environmental knowledge and argues that teachers can only integrate content knowledge with the subject matter if they have rich subject knowledge. Shulman (1987) regards teachers' content knowledge as a primary source of student understanding of subject matter. This indicates that giving wrong information may have a serious impact on learners' future performance (Nakale, 2012).

5.5.4 Gaps in preplanning

Data presented in Chapter 4 revealed gaps in the lesson plans of both teachers. Both teachers failed to indicate in their planning how much time they had set aside for teaching the topic. The CAPS document guides teachers as to how much time should be spent on each topic, scheduling topics broadly in weeks, while leaving the onus on the teacher to divide the subtopics according to the time they have available. Deciding what to teach, in what order to teach it, and how much time to allocate to each lesson are the basic components of planning. Although T1 had scheduled the teaching activities according to a pre-planned schedule it appeared that he underestimated the amount of time he needed for these activities, which resulted in his lessons running over time and into the next period, which in turn affected the next teacher. This overlap had to then be negotiated between the two teachers.

There was also no evidence of an outlined objective in the lesson plan. Although there are a variety of formats to use when creating a lesson plan, most templates share certain common characteristics. Clear lesson objectives are one of those characteristics. Lesson objectives are regarded as the most crucial aspects of planning as they provide a clear picture of what should be achieved by the end of the lesson. Lesson objectives make clear: the intended learning outcomes; what knowledge and skills the teacher wishes the students to attain; and what the teacher would like the students to know and to be able to do when the lesson is completed. Lesson objectives thus become the foundation of selecting learning activities and assessment measures. If the

teacher does not indicate what they want to achieve, how will they measure the success of the lesson?

In addition to a lack of lesson objectives, the lesson plan also lacked a clear outline of how the lesson was to be developed. It did not provide information as to how the lesson would be introduced, how new knowledge would be presented, or how the lesson would be concluded. A lack of objectives as stated above could have affected the structure of this lesson. It should be noted, however, that the lesson entailed a clear description of what students activities with specific time allocations for each activity, and how to engage them, as mentioned above.

5.6 Analytical Statement 5: Teachers' reflections on their teaching practice provided opportunities for teachers to identify strengths of their choice of teaching strategies and possibilities for improvement

From the discussions with the teachers during stimulated recall interviews as discussed in Section 4.6, it emerged that teachers consciously considered which methods to use as well as the limitations of such methods. When asked about the limitation of group activity in his practice, T1 was able to identify that stronger learners were more dominant. His choice of strategies seemed to be influenced by his experiences of the challenges in managing a class of that size and a need for learners to assist each other. However, he saw the necessity of rotating responsibilities in future lessons during group work so that every learner would be given an opportunity to participate.

Teaching strategies employed were intentionally shaped to assist learners in meaning making. One teacher indicated that the the use of various strategies was to cater for the varied needs of learners. Even though teachers seemed to have a fair knowledge of teaching strategies they were also able to identify some of the gaps in their practice and recognised opportunities for development. For example, when T2 identified lack of detail in his explanation of the greenhouse effect, he offered some suggestions as means to improve on this strategy (see Section 4.6).

5.7 Concluding remarks

This chapter discussed the findings which were presented in Chapter 4. Categories were used from which the analytical statements were derived. These statements enabled me to analyse and interpret data responding to the main research question, goal and sub-questions of the study. These enabled me to identify challenges experienced by learners in making meaning of biological concepts, strategies used to support learners, nature of these strategies in making meaning of biodiversity concepts, challenges that limit effective use of such strategies and teacher reflections on their practice. Evidence from data presented in Chapter 4 was used to support these claims. Literature was also used to provide insights in this regard.

In the next chapter I discuss a summary of my findings, recommendations and areas for further research. I also reflect critically on the limitations of the study.

Chapter 6: Summary of findings, recommendations and limitations

6.1 Introduction

This chapter presents a summary of the research findings in relation to the research questions. I then discuss the limitations and provide insights into possibilities and opportunities for further research.

6.2 Summary of the study and findings

This study is a case study of two East London schools in the Eastern Cape focusing on how Grade 11 teachers mediate biodiversity concepts with English second language learners. The study was motivated by my concern with examiners' reports in Life Sciences which constantly indicated problems encountered by second language learners in interpreting and answering various levels of examination questions leading them to missing marks which finally contribute to low levels of achievements in science subjects. These reports constantly claim these challenges are possible due to language problems. It then became of interest for me to investigate how educators assist learner despite the challenge of the language. The investigation was based on the assumption that it is possible for second language Life Science learners to have deep disciplinary knowledge if teachers know how to support them. The study then provided with insights into strengths and limitation of teachers in supporting learners when teaching biodiversity concepts.

With regard to the views of teachers on challenges faced by learners when making meaning of biodiversity concepts, it appeared that there was a variety of contributing factors which limit learner understanding of biodiversity concepts. Teachers claimed that learners had spelling problems which normally alter the meaning of words. They claimed this to be the common factor amongst English second language learners which normally cost them marks during exams. They also indicated that learners fail to interpret questions as a result they give wrong answers which are not worthy awarding marks. Teachers also claimed that biodiversity which is a broad concept with closely related concepts. Because this section is broad and have closely related terms educators felt that it often become a challenge for learners to make clear distinction among such

concepts which may lead to them confusing closely related terms and thus lose meaning of such terms.

Findings also showed that educators tend to plan learner engagement in response to such challenges. For example, in assisting learners with spelling problems educators claimed to use chalkboard to write correct spelling of words. Learners would then be encouraged to copy and write such words.

Teachers also seemed to value the use of learner familiar contexts to make meaning of biodiversity concepts. These were either in the form of use of prior knowledge or use of familiar pictures to elicit responses and make links with new knowledge. Use of such contexts seemed to promote dialogue and meaning making.

Findings also revealed that teachers seemed to have knowledge of teaching strategies to assist learner understanding of biodiversity concepts. A variety of teaching strategies were employed to assist learners to make meaning of biodiversity concepts. These ranged from breaking down of words to simplifying the seemingly complex words, use of learner context to allow learners to relate to context of environmental issues affecting biodiversity , use of mind maps to show conceptual connection, code switching and probing to guide and stimulate learner contribution. Most of the activities that the learners were engaged in appeared to be learner centered giving opportunities for learners to participate in learning with others which assisted in the development of co-operating, listening, responding and negotiation skills. Exposing learners to diverse forms of knowledge understanding appeared to be an attempt to make knowledge more accessible to learners.

It was also noteworthy that teachers were able to identify some of the limitations of their choice of strategies during stimulated recall interviews and how they were open to suggestions to improve where they could. This in my own opinion was a sign of professional maturity on the part of these teachers in this study.

It appeared that teachers were doing the best they could to assist learners despite language problems, however, there were some limitations in some of the strategies which highlighted areas which needed improvement. For example, on the part of their planning it appeared that there were some gaps in their teaching plans which could affect the direction of the lesson. For

instance, T1's lesson plan did not have lesson objectives which are one of the vital aspects of the lesson planning which sets direction of the lesson.

Also large class sizes seemed to limit individual attention that teachers are supposed to offer. Hence, these teachers opted to group work in assisting learners. It became difficult for teachers to do individual remedial work and accommodate all learners with different learning styles. Feedback was mainly in group form and the assumption was that it catered for everyone.

The chalkboard was also used to a limited extent where only key words were written. Most of the explanations were verbal, limiting opportunities of giving comprehensive summary of what was being taught.

From the conversation we had with the teachers it appeared that they were not so confident in teaching the knowledge area due to insufficient empowerment on the new concepts related to biodiversity. This became evident when T2 was unable to rectify the misconceptions on the causes of ozone depletion as he was convinced they were right.

6.3 Recommendations

6.3.1 There is a need to consider teacher-learner ratio for effective support

The teacher-learner ratio for School 1 was considerable high. Even though the teacher made every effort to accommodate all learners in the activities, as was evident from the observation, this was an almost impossible task. Many of the teaching and learning challenges are as a direct result of the large class numbers. Large class sizes call for use of group work activities in order to maximise lesson time allocated, which leads to some learners dominating the group space and weaker learners receiving little individual attention. Teachers used group assessment to mark learners' work, reserving only formal assessment for their own marking due to the difficulty in marking the work of such a large class. This could delay remedial intervention for some learners which may be picked up at an earlier stage if the teacher was able to mark individual's work. The school needs to consider teacher-pupil ratio and make necessary adjustments in this regard.

6.3.2 There is a need to capacitate teachers in environmental education

From the interviews with the teachers it emerged that there was a lack of confidence in teaching environmental knowledge, and that insufficient measures were in place to rectify this situation. Although they indicated that they had received some CAPS training in the form of workshops, after this new knowledge was added to the curriculum there seems to have been a lack of support for this knowledge area, affecting the teachers' level of confidence. In-service training to capacitate teachers with new content knowledge and to eliminate any misconceptions in the relevant subject areas (as noted with T2) should be ongoing.

6.3.3 There is a need to improve on chalkboard summary

Teachers indicated that they use the chalkboard to assist learners to spell words correctly. In reality, they tended to use the chalkboard in a limited way, spelling single words, or mapping simple concepts. Although the teachers verbal explanations in the class were comprehensive, the written component using the chalkboard was much more limited, which reduces note taking opportunities for learners. Learners then have little written content in their workbooks to use for other information gathering exercises in class, for writing opportunities, for revision purposes and for later reflection. Comprehensive chalkboard summary can provide thorough elaboration of ideas, encourage learners to relate various bits of information to each other, and to follow the logical progression of the lesson.

6.4 Limitations of the study

The study only focused on two schools in East London which were purposefully selected for easy accessibility as they are in the same cluster as the school where I teach. The existing relationship that I have with the schools may have compromised the validity of the study. The study only focused on English second language learners, and the scope of this study therefore does not allow for the findings to be generalised. In addition, the focus of the study was on the role of teachers in mediating learning with English second language learners, foregrounding teachers' views, actions and experiences without focusing on the experience of the learners.

Another challenge I faced in this study, was the difficulty in securing set lesson observation times, as the topic under study was only scheduled for the third term of the teaching year.

Teacher 1 had to reschedule the work for earlier in the year for the sake of the study. This may have compromised the natural flow of the teaching calendar. In addition, the number of lessons I observed for both teachers was not balanced, as I observed five lessons in school 1 and three lessons in school 2.

It was also difficult for me to schedule stimulated recall interviews immediately after each lesson and these were pushed to after the last lesson in each series. This may have compromised a more instantaneous sort of reflection should I have been able to schedule the recall interviews closer to the lessons themselves. For example, with T2 I realised that the teacher continued with the last lesson without looking at the homework given to learners on the previous day. As a result, there was some unnecessary confusion in the lesson that could have been avoided.

6.5 Areas for future research

- It has been noted that this research was limited to two schools only in East London. It is recommended that a similar research could be replicated with a larger sample to substantiate findings.
- I would recommend an extension the focus of the research beyond teachers to learners in order to understand their views on the challenges and effects of chosen teaching strategies on their learning.
- I would also recommend that further research be conducted on how teachers could be supported with subject content knowledge, teaching and assessment methods.

6.6 Conclusion

The study explored how teachers assist learners in making meaning of biodiversity concepts with English second language learners. Teachers in the study used a variety of teaching strategies and methods to assist learners in meaning making. There were, however, some limitations that affected the effective implementation as noted in the discussions above. Recommendations suggested could be used to influence improvement in teaching practice.

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Appendices

Appendix 1: Sample of color coding (SRI transcript)

Key

Yellow highlight = strategy/methods used

Light blue = challenges experienced

Purple highlight = interactions (learner-learner/teacher-learner/learner-activity)

Red highlight = Tools used to support learning (Language/LSTM)

Int2 T1

R: You started this lesson by asking learners what they know about ecosystem services before introducing the new concept to them. Why was that?

T: Whenever I start a new lesson I always check on their *previous knowledge* (TM/S). It becomes necessary because learners should not see knowledge as bit and pieces of knowledge but they must integrate it. Whatever they have done in the previous grade it was just a foundation. They need to see progression from grade 10-12. Like they have learnt about ecosystems in grade 10 that's not new. Building up on the knowledge from grade 10 will help them link the grade 11 work with grade 10 showing progression of content.

R: I noticed that the learners struggled to define the term biodiversity and when they struggled you broke the term into pieces for them to explain what was the reason for that?

T: You know from my experience you will find that in science we are confronted by complex words even if you are an English language speaker you find this terminology a bit intimidating and if one can actually understand the components of what the word is made up of it then becomes easier to connect it with that word you can actually relate the meaning behind using the components of the word. by this you try and bridge the fear of new strange words knowledge I encouraged them to break the word into pieces to have a better understanding of it (TM/S).

.R: When another complex word was introduced e.g. Resilience you used an example (TM/S). of a tree and wind to explain the meaning of the word why did you use a metaphor?

T: Like I said these big words have a tendency of scaring the kids so I used something that they can relate to. To a certain point it can give them a picture of what this means and probably better understanding of the new term.

R: How did you know they have an understanding of the word resilience then?

T: I assume they understood(CE) but I think I should have asked them to give me some examples of kinds of resilience in an ecosystem to check if they really understood the concept.

R: How do you think then this breaking down of terms assisted the learners to understand the concept?

T: Learners tend to have deeper understanding of the term once it is broken down even if you have to come across the terms that have the similar components they can apply the same method now in new situations (TM/S). Because before defining every term now they have to check if it is possible to split it to make things easier for them. Like when we came across evapotranspiration it became intimidating for them but had to split the word into evaporation and transpiration I had to kind of lead them by breaking the word and they were able to grasp the concept.

R: Looking at the first example learners seemed to struggle to understand what services are and you had to give an illustration of a car wash service...

T: I had to bring in something that they are familiar to. Giving them the example enabled them to relate the service offered by the car wash to a client and the term service (TM/S). I wanted them to arrive to the explanation on their own but with some little help of course.

Z: Do you think this assisted them in making meaning of the term?

R: Yes like when I explained(TM/S). the meaning of the word I then asked them to give some examples(TM/S). of services and products given by the ecosystem. They were able to point them out. You will find out that this concept applies in real life situations. I asked this question because it links with the real world so linking these with their experiences enabled them to identify the services and products offered by the ecosystem (TM/S).

R: Most of this work you started with is more relevant to grade 10 work where they learn about ecosystems and obviously one will have to touch on services as you did. Why did you find it necessary to go back to grade 10 work when dealing with this topic on human impact on biodiversity?

T: Eh, like I said there is progression of knowledge from grade 10-12. Learners need to understand that there is continuity instead of learning work as bit and pieces of knowledge.

I wanted them to understand the importance of biodiversity to our lives and how loss of biodiversity can affect us locally as well as globally. I also wanted them to make link between human activities their impact on biodiversity and how that can lead to changes in what nature provides us with (TM/S).

R: This activity was on the mind mapping what did you want to achieve with it?

T: *The mind map (TM/S). was there to consolidate and organise the key terms. They also need to learn to organise their work for study purposes. Because there were different activities within the group (TM/S). I wanted them have a bigger picture of how it fitted around this context of biodiversity. I was just like the way to sum up the key points.*

R: Your concluding activity involved choosing one term from those that they have studied and break the word and construct new terminology around it. What did you want to achieve using this method?

T: *I thought it would be nice to engage them in this because it just goes beyond that particular word because with each letter they had to think of another word that relates to term that they are focusing on (LE). I thought if they could expand on the vocabulary and stimulate that. You would have noticed that out of the same term different groups will come up with different terms that they can think of and each word they come up with should actually speak to the main term (LE).. When I went around the groups (TM/S). I would hear them talking about the terms and sometimes hear them arguing about it and i would say wow they are talking about the terms (LE). that's cool. Actually I was just surprised that it worked so well that one of the groups went beyond coming up with the words but created a sentence around each letter (LE).*

R: Learners did these activities within the group. What was your purpose of grouping learners?

T: *I wanted them to discuss these together (TM/S). stimulate talk amongst them (LE).. I was creating an atmosphere where they will be free to talk to each other using their own language.*

R: Does this mean you allow them to speak in the language that is not the language of instruction?

T: *Well during group discussion I become flexible because I want them to be free you know sometimes when they speak in their own language they talk a lot (LE). than they do in English however when they report I encourage them to speak in English so that they get used to the language. Their examinations are in English. I think it's because it stimulated discussions (LE). among learners and allowed them to start exploring (LE). the concept maybe in their own language even though they will have to discuss in English but not always. I gave them a space to discuss in a safe way. Instead of being*

asked questions and be put on a spot. I know from my own experience of being a learner I never gained much when somebody talks all the time I would lose my concentration in about five minutes. Ya I think the approach is **facilitation(TM/S)**, rather than lecture style you just give them tools they need to access knowledge. I was just creating an unthreatening space **where learners can talk(LE)**, about **in their own language** and they can still learn without the communication barrier

R: Did you notice anything during these discussions that you may say supported or affected learning in anyway?

T: **I think I did not put as much attention as I should(CE)** in their discussions but there were definitely good discussions going on and I was very impressed actually as they participated very well in the activities and I think they enjoyed what they were **doing even though you could pick up some very strong or dominating learner's in a group they seemed to have strong opinions about certain things(CE)** but I think the approach worked well despite challenges of space in the classroom. I was worried about that **having so many group activities and not having enough space hence we had to move outside(CE)**. We managed.

R: After the group discussions you encouraged presentations why did you do that?

T: The obvious reason **was for each group to(TM/S)**, **share** what they have been discussing. Some of the activities were assigned to different topic or key concept within the topic and by reporting that they **are sharing what they have learnt(LE)**, with the class but also give them **the opportunity to work on their presentation skills(LE)**, in their second language I think it's kind of helping them to get used to the language strengthening their communication skills kind of helping them to express themselves.

R: There is this activity where learners had to use pictures and align them with the Biomes and use them to also identify possible human benefits on the ecosystem as well as impacts. What was the purpose of using pictures in these activities?

T: I think **the pictures(LT)** were there to kind of contextualise the key terms. I tried to choose them intentionally representing the eastern cape context to try give them something that they can relate to. **Pictures(LT)** are a good way to introduce a new concept/term. Everything **is visual and picture(LT)** based. I think they relate better to **pictures(LT)** than words. **the pictures(LT)** also became a stimulus to spark the discussion within the **group and(TM/S)**, **getting them to describe(LE)**, what they see, which is also another **way of getting them to describe(LE)**, **what they see in the pictures** and also it **has**

implications of the language finding their own language (LT) to describe (LE). what they see i.e using Xhosa so that they don't get stuck with difficult definitions

R: you have mentioned that these pictures also stimulate talk which was actually evident within their group activities. These were coupled with some kind of information where learners had to read about a particular activity and decide whether it was an ecosystem service or human impact. Can you explain your intentions of giving such activities to learners?

T: *I think reading (LE). is one of the things that learners are still struggling to do (CE) i.e. reading to learn (CE). I wanted to include something in the lesson that would give them something to read to be able to sift through some text and try to find some key points in the text and keep them in the habit of reading (LE).*

R: How do you think this helped your learners?

T: *Reading (LE). is the key to language (LT) and vocabulary building and (LE). understanding the language (LT) more easily*

R: I have noticed from these activities that you related very well with your learners despite the large size of the class and you mixed different kinds of teaching approaches .What influences your choice of approaches?

T: *It has been always my teaching style. I have an experience of teaching all age groups but from my experience I have always found teenagers to be the most challenging group so (CE) I had to approach them in a way that they can relate to. I try to make them feel unthreatened and familiar in away so that they can relax and feel free. Also children have different learning styles. I am trying to accommodate all of them.*

R: You gave learners this essay on examples of human impact in their own communities. Was there any reason of asking them to look at their own communities instead of just writing generally on human impacts?

T: *I wanted to put this in their own context bringing the concept in their real life situations (TM/S). Sometimes you find out some topics apply to real life situations so I encourage them to link with what they are confronted with in the real world (TM/S). I also wanted them to think about it in terms of impacts in their own areas and what can they do to minimise it.*

R: I have noticed you are mixing different methods in your lesson why do you choose to use a cocktail of methods instead of just sticking to one?

T: *Since doing the same method over and over again may lead to boredom(CE) but once you are changing those different methods(TM/S). they become more comfortable and you will find that a certain group is interested in one method and the others are left behind so if you use different methods you try and accommodate those that you left behind in another method (TM/S). Like sometimes I will give them something to present you will find out that you give them an opportunity to express themselves and you also help them to learn in the way that is comfortable to them. They get a chance to hear from their peers ask questions like you are encouraging them to talk(TM/S).* You will notice that they learn better from their peers at the end you will find out everyone is catered for because every learner has a different style of learning.

Appendix 2: Sample of an analytical memo (interviews)

Category	Extract	Reference/source
Strategies/Methods used to support learning	I make sure I use chalkboard summary to write notes and words and explain so that they can get the correct meanings....	Int1-T1- ln36-37
Use of Chalkboard summary	I make a short summary of what I teach so that learners can take note of right spellings. I often highlight the key words by underlining them. Note taking assist in reading and writing of correct words. When marking their test I make note next to each wrong answer given so that the learner may know where he has gone wrong. In class I highlight common mistakes I have identified and clarify confusions When I am starting a new topic I will check the previous knowledge from the previous grade so as to link the information that they have already done in the previous grade. I start by finding out what the learners already know about the topic. You give the learners an opportunity to share anything they might know about the topic. This also helps you to gauge what their level of understanding is before you jump into the topic and whether you can use this as a base to introduce the new topic:	Int1-T2-ln34-38 Int1-T1ln-78-93 Int1-T2-ln99-102
Prior Knowledge		

• Use of learner context • Breaking down of complex terms	I use as many examples as I can to try and explain the meaning and I make sure I use examples that they are familiar with like you contextualise your examples	Int1-T1-ln102-108
	I find it helpful to use learners' context to explain some complex terms. For example when I teach them about the effect of deforestation on biodiversity, I normally refer to mushrooming of shacks in their own area and how that might have affected biodiversity in their own area	Int1-T2-ln77-80
	I normally break the words into the parts that make up the word because sometimes you will find out some words consist of 2 parts in it that you can break to make the meaning simpler.	Int1-T1-ln96-100
	Learners tend to have deeper understanding of the term once it is broken down even if you have to come across the terms that have the similar components they can apply the same method now in new situations In science we are often confronted with big words and these can intimidate learners. I know this from experience. To minimise that you just break the word into parts that simplify the meaning like it becomes now much clearer than giving the	In2T1ln28-30 In1-T2-ln69-75

	full description	
Challenges Spelling problems	Since my learners are from IsiXhosa speaking background it becomes difficult for them to understand certain concepts as they make spelling mistakes which have meanings that are totally different from what they are trying to explain. For example they will write lite instead of light, advantages instead of adventitious roots. Once such mistakes happen they cost them marks It becomes a problem because you will try and explain something and you see they are just blank they have no clue of what you are talking about and you end up taking a long time trying to explain one thing but once they get it they flow. Learners have poor understanding and mainly spelling mistakes.	Int1-T1-ln28-32 Int1T2-ln21-30
- Lack of interpretational skill - Lack of knowledge	In most cases data response questions are left un-attempted. I am not sure whether they get scared of these questions or what. It becomes worse when they are asked to formulate a hypothesis and predict the results of the experiment given I am very confident now but at the beginning I was scared to tackle this topic because I had not been exposed to this kind of content before	Int1-T1-ln58-66

Large class size	It is difficult indeed. You have to be a disciplinarian to manage. Quite honestly it's difficult to do justice as you cannot give individual attention. For class exercises they mark themselves. I just can't mark all the 77 I only mark their tests and exams. It is not easy at all but it's better than my grade 10 because I have 65 in one class. It's difficult to have one-on-one attention	Int1-T1-p-46-52 In1-T2-ln12-18
Complexity of knowledge	There are a lot of interrelated terms used in these topics which they often miss when not properly understood. It needs one to draw a distinction between these closely related terms..... The topic is vast and complex. There is so much terminology that learners are supposed to know and understand. Some definitions are closely related which learners often mix up and end up giving wrong answers	Int1-T1-ln68-77 Int1T2ln61-67

Appendix 3: Consent letters

Sophathisana Senior Secondary school
Reeston
East London
20 February 2014

The District Manager
East London District
East London

Sir

Subject: Request for permission to carry out a research study at Uviwe Senior Secondary School and Ebennezar Majombozi Senior Secondary School

I Zingisa Gqoloqa, a life Science teacher at Sophathisana Senior Secondary School requesting for permission to conduct a research study at the above indicated schools in April 2012.

I have registered as a part-time student at Rhodes University, Grahamstown (student number G11g6609) as from January last year doing a Master's degree in Science Education. I would be most grateful if you would allow me to conduct my research study at Senior Secondary School 1 and Senior Secondary School 2 during the month of April-May 2014.

My topic of study is "Understanding how grade 11 teachers mediate biodiversity concept with second language learners: A case study of East London Schools in Eastern Cape".

The insights generated from this study will be published in a thesis form and will become accessible to decision makers in education, curriculum developers, teacher educators and Life Sciences teachers in order to bring about improved achievements in Biology. Should I get permission, I will observe and film five lessons presentation, interview these two teachers at their free time.

The school, learners and teachers will be assured of anonymity of information provided and teachers will be allowed to go through the draft thesis to ensure that the details are correct.

Your understanding in this regard will be highly valued.

Yours Sincerely,

Z Gqoloqa (Mrs.)

Sophathisana Senior Secondary School

Dice Street
Reeston
East London
5247
20 February 2014

The Principal
School 1 and 2 Senior Secondary School
Duncan Village
East London

Sir

Subject: Request for permission to carry out a research study at Ebenezer Majombozi Senior Secondary School

I Zingisa Gqoloqa, a life Science teacher at Sophathisana Senior Secondary School requests for permission to conduct a research study at the above indicated school in April 2012.

I have registered as a part-time student at Rhodes University, Grahamstown (student number G11g6609) as from January last year doing a Master's degree in Science Education. I would be most grateful if you would allow me to conduct my research study at your school during the month of April-May 2014.

My topic of study is "Understanding how grade 11 teachers mediate biodiversity concept with second language learners: A case study of East London Schools in Eastern Cape".

The insights generated from this study will be published in a thesis form and will become accessible to decision makers in education, curriculum developers, teacher educators and Life Sciences teachers in order to bring about improved achievements in Biology. . Should I get permission, I will observe and film five lessons presentation in and, interview the teacher observed at their free time, look at lesson plans, learners' written work.

I assure the school, learners and Ms Swazi that everything will be treated confidentially and the participant reserves the rights to withdraw at anytime of the study should they wish to do so. Ms Swazi will be allowed to go through the draft thesis to ensure that the details are correct and I will not use the really name for the school and the teacher in my thesis.

Your understanding in this regard will be highly valued.

Yours Sincerely,

Z Gqoloqa (Mrs)

Sophathisana Senior Secondary School

Dice Street
Reeston
East London
5247
20 February 2014

School 1and 2 Senior Secondary School
Duncan Village
East London

Dear Parent

Subject: Request for permission for your child to participate in a research study at Ebenezar Majombozi Senior Secondary School

I Zingisa Gqoloqa, a life Science teacher at Sophathisana Senior Secondary School has requested for permission to conduct a research study at the above indicated school from 14-17 April 2014. I therefore request you to give permission for your child to participate in this research study.

I have registered as a part-time student at Rhodes University, Grahamstown (student number G11g6609) as from January last year doing a Master's degree in Science Education.

My topic of study is "Understanding how grade 11 teachers mediate biodiversity concept with second language learners: A case study of East London Schools in Eastern Cape".

The insights generated from this study will be published in a thesis form and will become accessible to decision makers in education, curriculum developers, teacher educators and Life Sciences teachers in order to bring about improved achievements in Life Sciences. Should I get permission, I will observe and film five lessons presentation and also look at your child's work.

I therefore request you to fill in the consent form attached for your child to participate in this study. I assure you that this recorded information will only be used for the purpose of the study. The school and your child's real name will not be used this study. Should you feel to withdraw your child from this study you will be free to do so at anytime without any questions. Your child also reserves the right to withdraw at any time should he/she wishes so.

Your understanding and cooperation in this regard will be highly valued.

Yours Sincerely,

Z Gqoloqa (Mrs)

Reply slip (Please fill in and return to school by 10 March 2014)

I.....Parent/Guardian ofhave given permission to participate in a research study that will be conducted at Ebenezar Majombozi High school from 14-17April 2014

Signed.....(Parent/guardian).....
Date.....

E-mail: Zinzangqoloqa@gmail.com

To: The Life Sciences Teacher

School 1

Dear Madam

Subject: Request for permission for Ms V Swazi to be a research participant in my research study at Ebenezer Majombozi Senior Secondary School

I Zingisa Gqoloqa, an employee at Sophathisana Senior Secondary school in East London District Eastern Cape, am hereby requesting you to be a participant teacher in my research study to be conducted at your school as from 14-17 April 2014.

I have registered as a part-time student at Rhodes University, Grahamstown (student number G11g6609) as from January last year doing a Master's degree in Science Education. I would be most grateful if you would allow me work with you during my research study in your school.

My topic of study is "Understanding how grade 11 teachers mediate biodiversity concepts with second language learners.

The insights generated from this study will be published in a thesis form and will become accessible to the decision makers in education, curriculum developers, teacher educators and Biology teachers in order to bring about improved achievements in Biology. Should you give me permission, I will observe and film four lessons presentations in one topic that we will have to agree upon, interview you at your free time, look at lesson plans and learners' written work

I assure you that everything will be treated confidentially and you reserve the rights to withdraw at anytime you wish so without any questions asked. You will be allowed to go through the draft thesis to ensure that the details are correct and I will not use your really name and that of the school.

Your cooperation in this regard will be highly valued.

Yours Sincerely

Z gqoloqa (Mrs.)

Appendix 4: Sample of semi-structured interview T2

R: Good day Sir

T2: Good day madam

R: Thank you for giving me this opportunity to do this interview with you. Can you briefly give me your background and the background of your school? Like what do you teach in which grades language spoken and language of instruction and anything you might find important for met to know.

T2: *okay I am teaching Life Sciences from grade 10-12 and natural science in grade 8. I have about 65 learners in grade 10, 45 in grade 11 and 37 in grade 12. We are all from Xhosa speaking background but the language of instruction is English. I hope I tried to answer everything.*

R: You seem to have a hand full of a class. How do you manage your class?

T2: *It is not easy at all(CE)but it's better than my grade 10 because I have 65 in one class. Its difficult to have one on one attention(CE). It becomes worse when you have to do practical they become so playful(CE). I normally do my practical(TM/S) after work or during weekends and I arrange with one of the teachers from my cluster to help so that there is somebody helping me. In some cases I take group(TM/S) leaders and do practical together where they will then be teachers in their own groups when we all gather together. In marking class works and homework I rely on peer marking I normally mark test and exams.*

R: Are there any advantages /disadvantages concerning the language context of your learners versus the language of instructions? If so explain.

T2: *Yes it becomes a problem because you will try and explain something and you see they are just blank they have no clue of what you are talking about and you end up taking a long time trying to explain one thin but once they get it they flow .Learners have poor understanding and mainly spelling mistakes(CE). Even though we are not that strict in marking spelling in Life Sciences once the wrong spelling of the word changes the context of the word , the learner is marked wrong which cost them marks(CE) Like in describing or identifying the phases of growth*

in population growth forms *they normally write leg phase instead of lag phase. If a question requires them to explain or discuss they normally leave it not that they do not have the content but they can't express themselves*(CE). That cost them a lot during exams as such questions are heavily weighted.

R: You indicated that some of the challenges your learners encounter is spelling of words incorrectly which normally cost learners during exams. How do you assist your learners in this regard?

T2: *I make a short summary*(TM/S) of what I teach so that learners *right can take note of spellings*(TM/S). I often *highlight*(TM/S) the key words by underlining them. *Note taking*(TM/S) assist in reading and writing of correct words. When marking their test *I make note* next to each wrong answer given so that the learner may know where he has gone wrong. In class I *highlight* common mistakes I have identified and *clarify* confusions(TM/S)

R: Life Sciences has language of its own which is normally assessed where learners are required to interpret information in data response questions. How do your learners respond to these?

T2 *In most cases data response questions are left un-attempted*(CE). *I am not sure whether they get scared* of these questions or what. *It becomes worse when they are asked to formulate a hypothesis and predict the results of the experiment given*(CE). *Let alone distinguishing between dependent /independent variables. They will state the aim instead of a hypothesis and put the independent variable in the place of dependent variable or vice versa*(CE). *You can just see they have no clue of what these words mean.*

R: How do you assist your learners in this regard?

I normally engage them with exercises with questions that require them to interpret information. If they practice a lot at least they become familiar with these kinds of questions and at least you find them attempting these.

R: The two strands biodiversity change and continuity and environmental education introduced some new topics on evolution of species and environmental issues that should be learnt in all grades. How do you find these topics?

T2: Well not so bad when you have the content. *The problem is that some of the topics were not part of our programme when we were trained as teachers like evolution and climate change(CE) which needs you to understand it first before delivering. It goes with ones attitude because if you do not know you must consult other sources like people who know better or just search from for information from reliable sources*

R: How confident are you in teaching these topics then?

T2: *Not confident at all when I started(CE) teaching evolution and environmental issues like climate change because I was not so sure of what I was talking about even in the CAPS workshops we had when CAPS was introduced the presenters seemed to have little knowledge or no clue . We had some guest presenters later on in our workshops in the district and I became more confident.*

R: How are your learners responding to this topic?

T2: *The topic is vast and complex. There is so much terminology(CE) that learners are supposed to know and understand. Some definitions are closely related which learners often mix up and end up wrong answers giving(CE). It becomes worse when they have to discuss these issues in examination they just do not have enough words to express themselves and they fall short(CE) in their discussion. Not that they do not have content but they struggle to put this in correct language(CE) because if we talk about these in class discussions where they sometimes use their language they just flow but when it comes to writing they get stuck.*

R: How do you help your learners in this regard?

T2: *In science we are often confronted with big words and these can intimidate learners(CE). I know this from experience. To minimise that you just break the word into parts that simplify the meaning (TM/S) like it becomes now much clearer than giving the full description. Like if you come across words like photosynthesis you just split the word Photo (light) Synthesis (make up) (TM/S) if the learner can understand the components of what the word is made up of then it becomes easier to connect if you had to relate the meaning behind the components of the word and this can bridge the fear of new strange words.*

R: Other than breaking these words are there any methods that you can share?

T2: I find it helpful to **use learners' context** to **explain(TM/S)** some complex terms. For example when I teach them about effect of deforestation on biodiversity, I normally refer to mushrooming of shacks in their own area and how that might have affected biodiversity in their own area

R: You have also indicated earlier on that learners do not have enough words to express themselves and not that they do not have content but they struggle to put whatever they are required to discuss in the correct language. Is there anything you do to help your learners to overcome this challenge?

T2; I normally encourage **group discussion(TM/S)** and **presentations(TM/S)** where they will **brainstorm(TM/S)** about these issues **within a group(TM/S)** then allow them to **present (TM/S)** their information. The more they talk the more they become used to speaking. I encourage them to do these **presentations(TM/S)** choosing any form they like ranging from **drama, poems, music** or just **normal presentations(TM/S)**. Whilst **presenting(TM/S)** other learners will critique and in the process learn correct use of words. Sometimes **give them essays** to write so that they get **used expressing(TM/S)** themselves through **writing(TM/S)**. As a teacher you just try everything as long as it works for you to achieve what you want.

R: Do you see any link of these new topics in the strands we have mentioned earlier on with other topics in life sciences?

T2: Yes most of the terminology in biological evolution for example in grade 12 link with the previous chapters in meiosis. If a learner has understood variations as a result of meiosis will be able to link with the sources of variation as outlined in biological evolution.

R: How do you strengthen such linkages?

T2: I **start by finding out what the learners already know (TM/S)** about the topic. You give the learners an opportunity to share anything they might know about the topic. This also helps you to gauge what their level of understanding is before you jump into the topic and whether you can use this as a base to introduce the new topic.

Appendix 5: Lesson plans

Learning program for grade 11 (T1)

Day 1 (Classroom)			
Time	Activity	Description	Resource Materials
10mins	1. Tuning in to Ecosystems and ecosystem services	A variety of pictures of different SA ecosystems and ecosystem services are handed out to groups of 5. Groups discuss what they see. Use the pics to prompt a discussion on the different ecosystems as well as the goods & services they provide. Create a biodiversity mind map emphasising key words & concepts	Pictures, poster paper, prestik, markers
15mins	2. Jigsaw activity	Hand out colour coded sections of the content in the TLSM. All those with the same colour get together and read and discuss key concepts. Once finished new groups are formed each person with a different colour and therefore representing entire content. Each person has the opportunity to share key concepts with rest of the group.	Sections of TLSM printed on different colour paper.
Day 2 and 3			
60 mins	3. Complete mind map	During feedback session the mind map is completed including all the key concepts covered in the jigsaw activity. The mind map will include the following headings: - What is biodiversity? - What is an ecosystem - Types of ecosystems - Ecosystem services - Indigenous vs alien - Human impact on biodiversity - Invasive alien species: one the biggest threats to biodiversity	Pre-made headings for mind map

		- What are IAS? - Why do some become invasive? - How do they spread? - IAS and Climate change - Impact of IAS in SA	
Day 4			
30min	Recap key words	Vocab activity: in groups learners select one of the key words which is written vertically down an A4 page. Learners have to find other words beginning with the letters that make up their chosen words. This activity gets the learners to relate known vocab relating to the key terms.	
		Day 5	
30min	Action ideas	Contextualising human impact on the environment	Learners in groups discuss examples of human impact on the environment in their own communities. Report back
30mins	Start working on activity sheet (individual work)	An activity sheet has been included in the TLSM to assess the learner's knowledge and whether learning has taken place. Go through all the questions first ensuring all questions and activities are clearly understood.	Activity sheets, red, blue & green pencil crayons, dictionaries

Lesson Plan Teacher 2

Grade:	Subject:	Week:	Topic:	Lesson no.
11	Life sciences		Human impact on the environment	
Lesson objectives				

<i>By the end of the lesson the learners must be able to:</i> • <i>Identify the different human activities which have a negative impact on the environment</i> • <i>Link the life sciences knowledge to real life situations around themselves</i> • <i>Analyse local national and global issues and their impact on biodiversity</i> • <i>Identify the sources of carbon emissions</i> • <i>Acquire and master life sciences terminology related to impact to the environment</i> • <i>To develop a positive attitude towards their environment so that they become responsible and accountable citizens of this country</i> • <i>To debate about the advantages and disadvantages of human activities on the environment</i>					
Lesson summary		Date started		Date completed	
Teachers activities		Learners activities		Timing	Resources needed
• <i>Introduction</i>	<i>Teacher introduces the lesson by mentioning the problems encountered in real life and asks the learners who is responsible deforestation</i> <i>Emphasise meaning of terms deforestation, pesticides biodiversity and ozone depletion</i> <i>Links prior knowledge to the lesson</i>	<i>Answer questions posed</i>			<i>Chalkboard summary</i> <i>Text book.</i>
• <i>Body</i>	<i>Make mind map summarizing impact of humans on the environment</i> <i>Recaps by asking one word questions</i> <i>Gives home work on page 339 (understanding life sciences) Reads and</i>	<i>Assist in breaking down of terms/word to give meaning to words/terms</i>			

Conclusion	<i>explains question</i> <i>Moves around and assist learners where the need arise</i>	Answer questions		
Class activity/home work	<i>Begins the lesson by asking the difference between climate and weather</i> <i>Explain observations providing evidence for rapid climate change</i> <i>Find out if the learners know the importance of greenhouse</i> <i>Explains greenhouse effect distinguishing between greenhouse effect and enhanced greenhouse effect</i> <i>Defines carbon footprint and distinguishes between a light and heavy carbon footprint</i> <i>Home work on page 328. Explains questions</i>	<i>Identify human impact and effects on the case study</i> <i>Answer questions related case</i>		
Day 2				
Topic: climate change		Answer questions		

Homework Day 3	Encourages learners to organize two groups for class debate. One group supports human activities on the environment justifying why humans use the environment the way they do The other group be against human activities and come up with possible solutions Facilitates reinforcing important points and clarify some points where possible	Listen and take notes Define terms		
------------------------------	--	--	--	--

			<i>Do the activity at home</i> <i>Brainstorm as groups for 10 minutes on the ideas they are to put forward</i> <i>Present their ideas in a form of a debate</i>		
	<i>Teacher reflections</i>				

Appendix 6: School 1 video transcript (lesson observation)

Lesson 1

Teacher begins to ask learners if they know anything about biodiversity. What is biodiversity? (TM/S)

Learners: Quiet no answer

Teacher: Request them to say i in their own words what they think it means. Don't worry about

Learner: Quiet

Teacher: Breaks the term into two...Bio- Diversity(TM/S) .

Learner: great variety of species(LE)

Learner 2: variety of plants and animals and organisms in a community(LE)

Teacher: Repeats what the learner has said (Int) (LE)

Teacher: And with biodiversity do we want so much do we want great variety. Do you want more or less

Learners: More (chorus)

Why is it important to have lots of biodiversity? Why can't we leave with ten or less plants and animals

Learner: We need them because some other species benefit from the others ,plants or animals depend on the other so if we do not have much some other plants or animals will suffer because there are no plants or animals that they depend on(LE)

Teacher: so you mean we all different species and plants depend on each other for survival if we have less some plants will not be able to survive(LE). The ecosystem where everything work together you take one thing will then the ecosystem will potentially collapse

Biodiversity also gives us resilience. Does anyone know what this means. Another buzz word

Blank quiet No

Teacher explains resilience means ability to withstand any kind of impact. For instance a very strong of tree that has deep roots can withstand heavy winds (resilient tom the wind) bends in the wind strong in the ground with huge amount of residence we stand ability to adapt to lots of different situations(TM/S)

With huge amount of biodiversity we have resilience. The most mistakes we make is to think we are separate from nature. Nature there people there

That is what our lesson is about biodiversity human impact on biodiversity

Most of the activities will be **done in groups(TM/S)**but our classroom dos not lend itself into group work how do you feel about working outside where we will have enough space

Teacher then organises learners into groups of ten

Activity 1

Each group is supplied with information pack(LT)

With information sheets on

Pictures of different human activities(LT)

Definition of terms

Terms/concepts

Instructions

Use green piece of green paper

2 strips of paper (terms and description)

Exercise 1 -match word with definition(LE)

Teacher: Stick the word and right definition. Let's see who the 1st to finish is

Learners begin to discuss the questions and read aloud

Learners: They begin to explain questions in their own understanding then question is tried out some arguments and disagreement emanated. **E.g description of the ecosystem " ecosystem is whereby organisms live together in spite of their differences their physical changes or their looks(LE).**

One learner should we write this mna am not happy nhe.

Mna guys I suggests that each of us come up with their own understanding of the question then the answer then combine our answer so that we come up with a common answer.

I think mna Tshomi Yindawo yabo like mna I would say it is where- it s where –where(emphasis on where) different organisms live and interact together. Oh! Unyanisile yindawo mna ndishiye lento ithi yindawo **(LE)**

Lets check on the strips(using the strips) **(LT)**

Learner reads out loud(they all agree) then the description is pasted next to the correct term **(LE)**

Example 2 : Indegenous zezifumaneka kulondawo zi originate khona. Organisms that grow naturally or originated in that particular area. Ok guys lets move this from here it does not belong here this means we still have to look for the meaning of this word **(LE)** (then they compare their answer with the strip they feel is the right description of the term) **(LT)**

Teacher moves around for help where required. Teacher is called to view the finished activity

Activity 2

Presentation **(TM/S)**

Learners are required to present from each group their work whilst others listen and make corrections where possible

Teacher: Put emphasis on what the leaner has said by rephrasing or repeating what the has said e.g

Leaner describes Invasive Alien species.....

Invasive Alien species. This just means they don't belong here .That's all they saying they don't belong to where they are. **(LE)**

Required to keep them ready for use in other activities

Activity 3

Teacher: This activity Involves picture of plants and animals lay them out for everyone to see. Take the piece of paper with question and picture of a map Read quickly together the information about biome in your information sheet

Look at the map of the South African biomes each colour is a different biome read from the information sheet read about description of each biome you have and then decide which biome your pictures belong to ,are your pictures from fynbos, Savana and so on .You just have to

decide which biome your pictures belong to.(re-emphasising)Try and decide what biome your pictures represent. Look at your pictures see how humans are benefiting from ecosystems (Ecosystem services). Also use these pictures to see how humans impact negatively on the environment. List these how humans are benefiting and how man is negatively affecting .Please shout if there's is any problem

Learners: lets read guys and explain in our own words or understanding (reading then translates) e.g(LE)

Biome is

Learner 1: an area where species can survive and are adapted(LE)

Learner 2: a place for that particular species and are adapted (LE)

Learner 3: I think mna guys lets just say it is a place where a group of organisms live and only because they live and adapt to that particular environment and climate.(agree on this one and write it down) (LE)

Teacher: (intervenes reinforcing instructions) Once you figure out what the biome is then say what this particular biome you have is . Put this on the top. Then look at the pictures and say which pictures of plants and animals belong to your biome(LE)

Then look at the human activities (poster is supplied to arrange the this information with subheadings) e.g (LT)

Our Biome is.....

Biodiversity in our Biome.....

Ecosystem services.....

Human impact.....

This will help you answer your questions easily

L: begin discussions on their own biome and paste pictures that they think is suitable

le.g(LE)

Learner : Ours guys is forest no guys **lemithi yomile**(LT) this picture cant represent the forest(LE) biome i forest biome **inetha kakhulu** (rains a lot)so there should be **imithi emininzi** (it should be densely populated with vegetation)le ipicture i dry guys. Trees should be long guys **ixinane kubekho** iforest plants (pictures representing a forest biome should be long and have a dense population of vegetation). **Look kuthwa apha kulento**(LT)

(this reads as follows) some of the plants that grow here are like yellow wood

L: **picks up a picture of a tree saying is yellow wood**(LT)

L: No guys this is tree is too short can't be yellow wood remember from our Life science book yellow wood appears to be a tall tree.(LE)

L : No guys it may look short in the picture because its still growing look at this picture there so many of these close(dense) lets take this one (all agree) (LE)

L: Hai mna guys mna ndiya yidoubt kwale biome siyi selectileyo mna kum this looks like a fynbos. **Lets go to themap**(LT)

and see . Lets go back to the readings guys(reading confirms is forest biome) (LE)

Example 2(another group)

L: Human impact guys.. Mining **xa gugrunjwa**(LT)

(learner literally translating what mining is) what is it in English digging.

L: How is that an impact guys

L: **When you do i mining you destroy i nutriens of the soil even though they get gold (soil science guys)(refereeing to agricultural science) and polluting the air or atmosphere that we breath,. Iya kulanto(it goes to) do you still remember what teacher Bottoman said in the investigation he gave to us (Physical sciences teacher) lanto yal acid rain eish cant explain lets leave it.ngu gorgeke ngoku ingxaki(meaning unable to explain in English (CE)) . Bhala sisi(write girl referring to the scribe) not dinging digging mining guys**(LE)

L: Eish look at the pictures with the hides(LE). When we want these hides for our traditional clothes we have to kill these animals. Eish nyhani(its true) the ecosystem will collapse.(realising what effect killing of animals would have on the ecosystem)

T: (Intervenes in the discussion) how does killing affect the ecosystem? (LE)

L: Before you get the hide you have to kill so you are destroying what is supposed to live. (LE)
Kaloku everything that lives on this earth has a reason to live. Some organism as i ecosystem isitsho i definition yayo so some organisms depend on the other so if you kill the organism i think some organisms will suffer and if those die then the others that were depending on them will not have something to eat then ecosystem will collapse . (Learners are trying to applying their understanding of the definition of the ecosystem in justifying how killing of animals can affect biodiversity (collapse of an ecosystem))

L: That's true that true

Teacher moves around help learners to re arrange some of the pictures they have put in some sub headings for example a picture of a bee pollinating is put under biodiversity found in the selected biome. Then the teacher explain the role of bees in the ecosystem through question and answer

T: What process is illustrated by this bee in this picture? (LT)

L: Pollination

T: What else do bees provide?

L: Pollinating and providing honey

T: So guys without bees -without pollinators we are in trouble we could actually run out of food. Its an important process that enables food production so we need biodiversity so that there is food. If we remove all the vegetation there will be no food for the bees they will die out. We also get honey you guys like honey.

Lesson 2

Teacher: I want to find out first how much you know about ecosystem services from what we did last time. Can any one try in your own words and give the description of what ecosystem services are. Just give an explanation in your own words what ecosystem is all about (TM/S).

Learner: quiet

Teacher: Ok let's break it down. Ecosystem, what does this mean (teacher writes the concept on the chalk board) (TM/S)

Learner: Ecosystem is an area where there is an interaction between living organism and the nonliving.

Teacher: (puts emphasis by adding on what the learner has said) Nice and short description so an ecosystem is where there is an interaction between non living and living interacting with each other in the environment so they are depending on each other for survival.. if we want to use the science language we may say the biotic and the abiotic. Abiotic stands for....?

Learners: Non living

Teacher non living and what kind of non living things would you find in an environment.

Learners: Water, air, soil

Teacher: I am not sure if we can put soil in there because soil has got living creatures in it soil is full of life but obviously soil is made up of rocks and minerals which are non living (LE)

Ok we have got an ecosystem and we know what it is. What about services. What is a service? What do you understand by the word service? You do not have to explain it in terms of biology. Like if you go to a car wash they are providing you with a service. So how do you describe this word service? (TM/S)

Learner: if you go to a car wash and then they wash your car they are giving you service they are providing you with what you need. (LE)

Teacher: They are providing with what you need i like that. Then can you see from what these two words mean we have an ecosystem that is providing us with what we need. It is a very people orientated concept (LE)

Let us have a look at some of those benefits. What are some of those services? Can you give some examples of how nature gives some of those services and products goods?

Learners: materials for us to build our house like we use stones, wood, clay, sand

What else

Hides of the skins

Should we say animal products e.g Inyama what are the other animal products

Milk cheese eggs ,honey

What about the services animals provide

Transport ,

Think about big and small animals

Dogs for security, cats catch mice at home

What kind of service can insects provide us?

Pollination

This is a very important process and without this process happening we would all disappear. If the bees and other insects that are pollinators would disappear we would not have food because most of our food that we eat is a result of pollination. We won't get the fruit we won't get the wheat and so on. Do you understand that pollination is critical to our survival.

Ok what else what are other small creatures provide service to us. Think of the creatures without which our world would be a very dirty uninhabitable place. What creatures are helping us to clean up and recycle waste? (TM/S)

Flies, bacteria, fungi

What do they do?

Decompose

What other services

From the plants we have our Muti

What about trees. What do trees do for us?

Furniture, they give us oxygen

Carbon dioxide and oxygen cycle. (gives brief explanation of the concept) a very good exchange between animals and plant. We kind of benefit from each other. We exist together. If we remove those trees what will happen

We are going to have a very big problem. Increase of carbon dioxide in the atmosphere can't breathe

Another thing that the plants do is what is called evapotranspiration. Another important concept. Do we know what this is. Ok Evapo comes from the word..? (TM/S)

Evaporation

And what does that mean? (TM/S)

Water changes into gas

Ok plants get water from the soil and use some of that water for their own processes then release some of the water through their leaves in the form of water vapour and that process is known as..? (TM/S)

Transpiration

Then when that gas reaches the clouds what happens

Teacher uses waves hand to show movement of this gas back to the soil (gestures) (TM/S)

Condensation then precipitation

Ok so when we cut down those trees not only will we lose biodiversity we will also affect the weather and it's happening already especially in other parts of Africa where we have lost plants e.g. where there is a lot of desertification do you know what that is (TM/S). When landscapes are turning into deserts. Writes the term on the chalk board (TM/S).

We have also water purification by wetlands and trees where these act as a sponge. Do you know what a sponge is? What does it do? Sort of filters water in it cleaning (TM/S)

Ok with these few examples you should know what ecosystem services are

Activity Group activity

Mind map all the information gathered. Capture points in a mind map(TM/S). Useful for your study. Capture and organise all the concepts. Each group will get one word or concept as a heading. Try and get all what you can remember of what this word entails(LE)

Teacher moves around explaining the instruction that seem not to be understood well. Each group has a concept e.g invasive alien species. They need to describe what it is and how it affects biodiversity. Each group is supplied with some reading material for further information. (LT)

Example 1(learners discussing about effect of alien plants on biodiversity)(LE)

L: Aliens plants are plants that do not grow naturally in that area.(learners verify this definition on their textbook) (LT) Let's explain now how these affect biodiversity. (LE)

L: Remember guys' bekuthwe alien plants like Pine trees they use a lot of water. They take most of the water that can be used by other plants, if other plants can't have water they will die then biodiversity of indigenous plants is decreased(LE)

L: Another thing they take all the space and food for other plants in that way they are invasive(LE)

Learners' discussions and presentations

Biodiversity is at the center then the other terms arise/expand from the main concept.

Each group comes and present and the teacher emphasises what learners have said) Lesson 3

What are the words or the terms that we have been learning about?

Ecosystem, Biomes, Invasive plants, Ecosystem services, indigenous plants, impacts, biodiversity (central theme)

Lesson 3

Ok today we we practice our vocabulary on what we did last time. Our lesson is based on vocabulary building. You will use this A4 size sheet of blank paper where you will write one term vertically and use each letter that form that word to come up with a term that relates to biodiversity(TM/S).

Each group must select its own term different to others and build upon their vocabulary.

Let us choose now each word, take a piece a sheet of paper. Say if you choose BIOME you will write

B

I

O

M

E (illustration on the chalk board) (LT)

You take each of these letters and try and come up with other concepts that describe what a Biome is for example B could stand for biodiversity but let us make sure each group choose a different term.

Learners **begin to discuss (TM/S)** the activity

Example no 1

Each group **shares (TM/S)** their work with rest of the class

B-iodiversity(these consists of different times of organisms and each biome has its own)

I-ndegenous(some organisms grow naturally in a certain biome

O-ganisms(some organism live can be found in certain biomes

M-arine(we have also sea)

E-cosystems(there is interaction between non living and living)

S -revives(products and goods provided by ecosystems) **(LE)**

Good **does any one of you see any word that does not fit there? (LE)**

Marine we do not have marine biomes

What else can we put then to replace that word

Monoculture

What does that mean/ how does it fit in. May be monoculture means where one plant the same crops every year. May be we can fit it where only certain biome can only support certain kinds of crops. Where we will have to plant such crops over and over again e.g. wheat in a grassland biome

Groups with similar concept only bring up new terms not covered by the group

Example no 2(ZPD)

B-biodiversity

I-n

O-organisms

D-differentiated

I-n

V-various-

E-environments

R-release

S-South African

I-indigenous

T-trees

Y-yearly(TM/S)

These learners decided just to create a sentence that can describe the word (different approach) (TM/S)

Lesson 4

The lesson will be more of contextualising human impact on the environment. It is important that we do not see this as something that is happening out there. We also have some activities that we do that impact on our environment in our areas. **Let us form groups(TM/S)** where we will **brainstorm about(TM/S)** some of examples in our own communities. Those who are staying in the same locality must be in the same group so that you remind each other of the impacts in your own environment. Don't only come up with impacts of these activities but also suggestions on how to minimise these.

Example 1

L:I think **mna guys lento yokubuilda amagali(LT)** (mushrooming) affects i environment. Like look le area yase Reeston is **ungena nje eteni** (when you enter this area from the main road) its full of **amagali** even nabantwana abangangathi (even young people of our own age)have their own places to stay. **Like xa sisakha amagali**(when we build) we remove plants.

L:**Umntu uzinceda noba kuphi** like there are no toilets. We don't have proper sanitation here

Sidumpa inkukuma(LT)(we dump rubbish)in every available place

(Teacher comes to the group and intervenes) Lets not just mention these activities let us say how they affect our environment specifically biodiversity. Like if you talk about amagali as you say .how are they affecting the environment and so on. Then once you finish look at possible solutions to this. Teacher supply each group with posters for presentation) **(LE)**

Ok let's start with amagali. We remove trees, plants we reduce the number of trees

T: good (that's loss of biodiversity) We need to look further are the trees the only ones affected what about animals. Why are trees important? What happens if we lose them? **(LE)**

Like Inkawu guys imivundla **(LT)** (monkeys and hare) will not have a place to stay. We are destroying the habitat.

But mna I don't think it's a problem that one we are not killing them like we do in plants

But still we are taking their own places to live then they will have to go to another place to live. They also get food from these trees if they don't have food what will happen they will still die

Ok lets say what we can do to minimise this. Like mna I think people must stop building amagali

Yho uthi mabahlalephi **(LT)** (where do you expect them to stay)

We must also tell people to plant trees in their homes even if its fruit trees

T: Reporting time if you have not finished you can continue later in your own time it will help you to write the essay

Learner reporting (TM/S)

In our area we identified shacks, dumping of waste and no toilets. When we build we remove trees. Plant make foods through photosynthesis. We destroy the living places of animals and also their food. To minimise this we said people must stop building shacks like if one is still young must stay with parents at least there will be less shacks than we have. We also said people must plant trees in their homes even if its fruit trees.

Ok any questions from the rest of the class

Quiet

T: I want to know how dumping of waste and no toilets affect biodiversity? **(TM/S)**

We did not talk on this because of time but like waste can go to rivers and make water dirty and kill animals that live there **(LE)**

You should be by now using the terminology we learnt about in our previous lessons. **If we remove trees what process is that? (TM/S)**

Deforestation

What about living places of organisms? What do we call the natural living place of organisms? (TM/S)

I think it is habita (LE)

Say it again I can't hear what you are saying

Habita mem

Its habitat (teacher slowly pronounces the word emphasising the letters that form the word) there is a'' t'' don't swallow this word (teacher writes the correct spelling on the chalk board) (TM/S)

Good if there are no questions from the class you may sit down. This group has looked at mushrooming of shacks as a cause for deforestation. Deforestation reduces biodiversity of plants and animals. It results to habitat loss. It also affects the process of food production in plants. Which process is this?

Photosynthesis

What gas is needed by plants to do this process?

Oxygen

Is oxygen needed or released during this process (TM/S)

Carbon dioxide is needed for photosynthesis

What will happen if plants are reduced then? Will it increase or decrease? (TM/S)

Increase

Yes good it will increase remember carbon dioxide is one of the greenhouse gases that contribute to enhanced green house effect but that's another topic for another day but we need to know environmental issues are complex and they affect us locally and globally.

Lesson 5

Teacher distributes work sheets. Ok this worksheet s contains information that gives us a background on alien invasive species and a summary of the concepts we have learnt. Let us Read(TM/S) this information first and answer questions that follow. This will help us answer the questions attached here. Each one of us will take turns to read.

L: Read aloud some listen

T: Corrects pronunciations of some words e.g. catchment not cashment. Do you know what a catchment is?

LL: No

The river, dams, lakes are catchment like water drains into them. They act like basins that hold water(TM/S)

Teacher then reads questions and explains(TM/S) how learners are expected to respond. E.g gives examples of different ecosystem. Here you are required to give examples people you just list there is no need to describe or explain (that is give account of) that question just needs your recall. It is important to look for a key word in a question(TM/S) it is the one that guides you how to answer a question. Once a question start with how or why this means you need to explain. Let us look at this one. How do alien plants reduce biodiversity? To answer this question we need to apply our knowledge on alien plants. What are they? What do they do? How do they affect biodiversity then?(LE) All this information is here if you are stuck just check from your worksheet

Appendix 7: Stimulated recall interview

Int2 T1

R: You started this lesson by asking learners what they know about ecosystem services before introducing the new concept to them. Why was that?

Whenever I start a new lesson I always check on their **previous knowledge(TM/S)**. It becomes necessary because learners should not see knowledge as bit and pieces of knowledge but they must integrate it. Whatever they have done in the previous grade it was just a foundation. They need to see progression from grade 10-12. Like they have learnt about ecosystems in grade 10 that's not new. Building up on the knowledge from grade 10 will help them link the grade 11 work with grade 10 showing progression of content.

R: I noticed that the learners struggled to define the Term biodiversity and when they struggled you broke the term into pieces for them to explain what was the reason for that?

T: You know from my experience you will find that in science we are confronted by complex words even if you are an English language speaker you find this terminology a bit intimidating and if one can actually understand the components of what the word is made up of it then becomes easier to connect it with that word you can actually relate the meaning behind using the components of the word. by this you try and bridge the fear of new strange words knowledge I encouraged them to break the word into pieces to have a better understanding of it(TM/S).

R: When another complex word was introduced e.g. Resilience you **used an example(TM/S)** of a tree and wind to explain the meaning of the word why did you use a metaphor

T: Like I said these big words have a tendency of scaring the kids so I used something that they can relate to. To a certain point it can give them a picture of what this means and probably better understanding of the new term.

R: How did you know they have an understanding of the word resilience then?

T: **I assume they understood(CE)** but I think I should have asked them to give me some examples of kinds of resilience in an ecosystem to check if they really understood the concept

R: How do you think then this breaking down of terms assisted the learners to understand the concept?

T: Learners tend to have deeper understanding of the term **once it is broken down even if you have to come across the terms that have the similar components they can apply the same method now in new situations(TM/S)**. Because before defining every term now they have to check if it is possible to split it to make things easier for them. Like when we came across evapotranspiration it became intimidating for them but had to split the word into evaporation and

transpiration I had to kind of lead them by breaking the word and they were able to grasp the concept.

R: Looking at the 1st example learners seemed to struggle to understand what services are and you had to give an illustration of a car wash service

T: I had to bring in something that they are familiar to. Giving them the example enabled them to relate the service offered by the car wash to a client and the term service. (TM/S). I wanted them to arrive to the explanation on their own but with some little help of course

Do you think this assisted them in making meaning of the term

Yes like when I explained(TM/S). the meaning of the word I then asked them to give some examples(TM/S). of services and products given by the ecosystem. They were able to point them out.

You will find out that this concept applies in real life situations. I asked this question because it links with the real world so linking these with their experiences enabled them to identify the services and products offered by the ecosystem(TM/S).

R: Most of this work you started with is more relevant to grade 10 work where they learn about ecosystems and obviously one will have to touch on services as you did. Why did you find it necessary to go back to grade 10 work when dealing with this topic on human impact on biodiversity?

T: eh: Like I said there is progression of knowledge from grade 10-12. Learners need to understand that there is continuity instead of learning work as bit and pieces of knowledge.

I wanted them to understand the importance of biodiversity to our lives and how loss of biodiversity can affect us locally as well as globally. I also wanted them to make link between human activities their impact on biodiversity and how that can lead to changes in what nature provides us with(TM/S).

R: This activity was on the mind mapping what did you want to achieve with it?

T: The mind map(TM/S). was there to consolidate and organise the key terms. They also need to learn to organise their work for study purposes.

Because there were different activities within the group(TM/S). I wanted them have a bigger picture of how it fitted around this context of biodiversity. I was just like the way to sum up the key points.

ZR: Your concluding activity involved choosing one term from those that they have studied and break the word and construct new terminology around it. What did you want to achieve using this method?

T: I thought it would be nice to engage them in this because it just goes beyond that particular word because with each letter they had to think of another word that relates to term that they are focusing on(LE). I thought if they could expand on the vocabulary and stimulate that. You would have noticed that out of the same term different groups will come up with different terms that they can think of and each word they come up with should actually speak to the main term(LE)..

When I went around the groups (TM/S).I would hear them talking about the terms and sometimes hear them arguing about it and i would say wow they are talking about the terms (LE). that's cool.

Actually I was just surprised that it worked so well that one of the groups went beyond coming up with the words but created a sentence around each letter(LE).

R: Learners did these activities within the group. What was your purpose of grouping learners?

T: I wanted them to discuss these together(TM/S).stimulate talk amongst them(LE).. I was creating an atmosphere where they will be free to talk to each other using their own language.

R: Does this mean you allow them to speak in the language that is not the language of instruction

T: Well during group discussion I become flexible because I want them to be free you know sometimes when they speak in their own language they talk a lot(LE). than they do in English however when they report I encourage them to speak in English so that they get used to the language. Their examinations are in English. I think it's because it stimulated discussions(LE). among learners and allowed them to start exploring(LE). the concept maybe in their own language even though they will have to discuss in English but not always. I gave them a space to discuss in a safe way. Instead of being asked questions and be put on a spot. I know from my own experience of being a learner I never gained much when somebody talks all the time I would lose my concentration in about five minutes. Yha I think the approach is facilitation(TM/S). rather than lecture style you just give them tools they need to access knowledge. I was just creating an unthreatening space where learners can talk(LE). about in their own language and they can still learn without the communication barrier

R: Did you notice anything during these discussions that you may say supported or affected learning in anyway ?

T: I think I did not put as much attention as I should(CE) in their discussions but there were definitely good discussions going on and I was very impressed actually as they participated very well in the activities and I think they enjoyed what they were doing even though you could pick up some very strong or dominating learner's in a group they seemed to have strong opinions about certain things(CE) but I think the approach worked well despite challenges of space in the classroom. I was worried about that having so many group activities and not having enough space hence we had to move outside(CE). We managed

R: after the group discussions you encouraged presentations why did you do that?

T: The obvious reason was for each group to (TM/S). share what they have been discussing. Some of the activities were assigned to different topic or key concept within the topic and by reporting that they are sharing what they have learnt (LE). with the class but also give them the opportunity to work on their presentation skills (LE). in their second language I think it's kind of helping them to get used to the language strengthening their communication skills kind of helping them to express themselves.

R: There is this activity where learners had to use pictures and align them with the Biomes and use them to also identify possible human benefits on the ecosystem as well as impacts. What was the purpose of using pictures in these activities

T: I think the pictures (LT) were there to kind of contextualise the key terms . I tried to choose them intentionally representing the eastern cape context to try give them something that they can relate to . Pictures (LT) are a good way to introduce a new concept/term. Everything is visual and picture (LT) based. i think they relate better to pictures (LT) than words . the pictures (LT) also became a stimulus to spark the discussion within the group and (TM/S). getting them to describe (LE). what they see , which is also another way of getting them to describe (LE). what they see in the pictures and also it has implications of the language finding their own language (LT) to describe (LE). what they see i.e using Xhosa so that they don't get stuck with difficult definitions

R: you have mentioned that these pictures also stimulate talk which was actually evident within their group activities. These were coupled with some kind of information where learners had to read about a particular activity and decide whether it was an ecosystem service or human impact. Can you explain your intentions of giving such activities to learners

T: I think reading (LE). is one of the things that learners are still struggling to do (CE) i.e. reading to learn (CE). I wanted to include something in the lesson that would give them something to read to be able to sift through some text and try to find some key points in the text and keep them in the habit of reading (LE).

R: How do you think this helped your learners

T: Reading (LE). is the key to language (LT) and vocabulary building and (LE). understanding the language (LT) more easily

R: I have noticed from these activities that you related very well with your learners despite the large size of the class and you mixed different kinds of teaching approaches .What influences your choice of approaches.

T: It has been always my teaching style. I have an experience of teaching all age groups but from my experience I have always found teenagers to be the most challenging group so (CE) I had to

approach them in a way that they can relate to. I try to make them feel unthreatened and familiar in away so that they can relax and feel free. Also children have different learning styles. I am trying to accommodate all of them.

R: You gave learners this essay on examples of human impact in their own communities. Was there any reason of asking them to look at their own communities instead of just writing generally on human impacts?

T: I wanted to put this in their own context bringing the concept in their real life situations(TM/S). Sometimes you find out some topics apply to real life situations so I encourage them to link with what they are confronted with in the real world(TM/S). I also wanted them to think about it in terms of impacts in their own areas and what can they do to minimise it

R: I have noticed you are mixing different methods in your lesson why do you choose to use a cocktail of methods instead of just sticking to one

T: since doing the same method over and over again may lead to boredom(CE) but once you are changing those different methods(TM/S). they become more comfortable and you will find that a certain group is interested in one method and the others are left behind so if you use different methods you try and accommodate those that you left behind in another method(TM/S). Like sometimes I will give them something to present you will find out that you give them an opportunity to express themselves and you also help them to learn in the way that is comfortable to them. They get a chance to hear from their peers ask questions like you are encouraging them to talk(TM/S). You will notice that they learn better from their peers at the end you will find out everyone is catered for because every learner has a different style of learning

Appendix 8: Document analysis

Type of Document	Grade	Content of learning	Key assessment skills	Language support	Context specificity	Example of activities
CAPS	11	Interactions in the environment p.50 Population ecology p51 Impacts of humans on the environment p.51-52	Define, describe, list, illustrate observe measure, record	Encourages use and practice of cognitive skills in teaching and assessment to assist learners in knowing and understanding biodiversity science ,applying this knowledge to new and unfamiliar context and analyse ,evaluate and synthesise biodiversity knowledge	Subject specific Aims3 indicates realisation of relevance and application of the science of biodiversity in real life contexts	Measuring and comparing species diversity observe interactions Identify human impacts Discuss implications on biodiversity Design /suggest solutions to local biodiversity problems
Textbook Understanding Life sciences	11	Population ecology and human impacts on the environment p.268-391	Define, describe, list, illustrate observe measure, record	Illustration of concepts using pictures Full description and definition of terms supplied and highlighted Local examples used to illustrate concepts e.g use of examples of South African environmental issues	Local context used to illustrate and explain concepts	Data response questions that require answer questions based on that p.274,280(information presented in graphs and tables) Simulation practical that assist learner understanding of estimation of population size p.282 Investigation activities p.284-287 Case studies based on local environmental issues e.g. on culling of elephants p. 289, use of energy by different sectors in SA p.335, elephant and Rhino poaching in SA

						p.374
Learners work School 1 Assessment activity- Worksheet	11	Invasive alien species a biggest threat to biodiversity	Explain, give, discuss, describe, compare	Reading material supplied pictures used to explain concepts	Local context used to illustrate and explain concepts	Explain biodiversity and ecosystem, present plants and animals in riverine ecosystem in a food web Give examples of ecosystem services Explain conditions that often favour IAS and be detrimental to Indigenous species Case study on deadly weed choking Nahoon River(localised)
School 2						
Assessment Activity 1	11	Global warming and its effects	Describe ,explain ,list	Reading from the textbook		Describe ways in which humans add carbon dioxide to the atmosphere Explain ways in which deforestation leads to increase in levels of GHGs Explain how depletion of ozone layer brings about global warming
Activity 2	11	Human impact on the environment	Describe, explain, suggest	Picture based case study is used to illustrate the concept	Familiar context used to illustrate concept e.g. industrial development and farming development	Use the map of the river to explain how the development affects biodiversity in this river Case study on deforestation Suggest strategies that would allow use our plant resources such as Hoodia and African Potato in a sustainable way

Appendix 9: Observation schedule (sample)

Introduction of the lesson How was new knowledge introduced?	
Instructional strategies/Methods of presentations What strategies/methods were used to support learning? How were they used How did the learners respond	
Learner engagement How are learners engaged- to what extent- what is the teachers role during the lesson?	
Learning interactions Context of interactions Learning support material used (how it supports learning)	
How was language used? Between the educator and group of learners Between educator and individual learners Between learners and learners	
Assessment of learning What methods of assessment were used? How were they used? Was there any evidence of learning?	