

**An exploration of how Professional Learning Communities can contribute to the
development of teachers' capabilities and valued functionings in teaching
environmental content knowledge in the Life and Living strand in Grade 8 Natural
Sciences**

A thesis submitted in partial fulfilment of the requirement for the degree of

MASTERS OF EDUCATION: ENVIRONMENTAL EDUCATION

RHODES UNIVERSITY

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January 2019

ABSTRACT

The study explored how professional learning communities can contribute to the development of teachers' capabilities and achievement of valued functionings related to teaching environmental content knowledge in the Life and Living strand in Grade 8 Natural Sciences. This is in the context of the Curriculum Assessment and Policy Statement (CAPS), which is a content-referenced curriculum that requires active and critical approaches to learning, and to environment and sustainability content.

This study is designed as a qualitative case study of a professional support forum (PSF) in the Mahikeng sub-district, in North West. The study made use of questionnaires, observations, interviews and document analysis as data generation methods. The Capability Approach was used as a theoretical and conceptual framework to explore teachers' valued functionings, as well as the conversion factors related to those functionings. A functioning is defined as what a person values to be or do, hence the term valued beings and doings has been used interchangeably with the term valued functionings throughout the study.

The analysis of data was done in three phases. Phase one analysis was inductive with the data from questionnaires, classroom observations, document analysis (work schedules and lesson plans or preparation books). The purpose of this phase was to answer the first research sub-question of how teachers teach environmental content. Phase two was a deductive analysis, and the purpose was to present teachers' valued beings and doings in teaching environmental content, and in belonging to the PSF. The last phase of analysis was abductive, and it employed the theoretical framework of Sen's Capability Approach to get a deeper understanding of factors that either enabled or constrained teachers' valued beings and doings associated with their capabilities.

The study found that teachers have gaps in their environmental content knowledge in the Life and Living strand grade 8 Natural Sciences. This was mainly as a result of teachers not having relevant qualifications, and/or not having any professional development in teaching the environmental content knowledge. Secondly, teachers used traditional methods which were teacher-centred to teach environmental content knowledge. The gaps in the environmental content knowledge were constraints to how the teachers taught environmental content in their classrooms. Teachers' valued beings and doings related to teaching environmental content were discussed under the three conversion factors of the capability approach: personal, social

and environmental conversion factors. The study found that teachers' qualifications, experiences, passion for environmental content topics, level of confidence, teaching and learning resources, learners' interest and participation, support, classroom and schools' environment were among conversion factors that either enabled or constrained teachers' valued functionings in teaching environmental content.

Findings also revealed that teachers have different valued functionings related to belonging to the PSF: shared responsibilities, shared values and vision, collaboration, and discussion of subject content. The conversion factors related to these functionings were found to be learning space, time and duration of the PSF, activities in the PSF, teaching and learning resources, teaching experience, and facilitation.

The study recommends that teachers' professional development programmes should promote subject content discussions as well as group and individual learning. They should also create supportive conditions that will expand teachers' capabilities in teaching environmental content knowledge. Lastly, the teachers' professional development programmes should explicitly take into account teachers' valued functionings and conversion factors that can enable teachers to develop their professional capabilities.

DEDICATION

This thesis is dedicated to all those who are working towards teacher professional development in education for sustainable development.

ACKNOWLEDGEMENTS

To my Lord and Saviour, Jesus Christ. I am grateful for the grace, wisdom and strength You granted me throughout this study.

My heartfelt acknowledgement goes to my supervisor, Ms Zintle Songqwaru, for her tireless guidance and support from the beginning of my study. I really appreciate how you always gave me detailed feedback on every piece of writing I sent to you. You never kept me waiting no matter how busy you were. And those “check in” emails you sent every now and then to check how I am doing meant a lot to me. Thank you.

I am also grateful for the Environmental Learning Research Centre family. It has been a very rewarding journey. Thank you to all the supervisors and everyone else who contributed to my development and learning, through the Masters programme sessions.

To the M.Ed. class of 2017/18, you guys made our programme sessions something to look forward to. Thanks for your support. A special mention to Vee (Vhutshilo Mushwana) we have been in this together since day one, and I cannot even begin to express it all here. Thank you for all the support and for being my midnight partner during our stays in Grahamstown.

I should also show my gratitude to Dr Charles Chikunda, for the guidance you gave me when I was confused about my career. You led me in the right direction. Thank you also for the Capability Approach reading materials you always shared with me. You enabled me to achieve my valued beings and doings.

To the North West Department of Education for offering me a bursary, and permission to work with teachers. The teachers who allowed me to get into their classrooms, thank you.

A special appreciation to my family and friends for your support; and everyone else who always asked how the study was going.

To my spiritual family, thank you for your prayers and support.

And the best for last. My heartfelt gratitude goes to my number one supporter, my cheerleader, my mentor, my friend, and the love of my life Reuben Thifhulufhelwi. You are the one who encouraged me to apply for this M. Ed, and you gave me all the support and encouragement throughout my studies. I cannot tell it all, but all I can say is: you are the best babe.

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ACRONYMS

ANA	Annual National Assessments
ATP	Annual Teaching Plan
CAPS	Curriculum and Assessment Policy Statements
CPTD	Continuous Professional Teacher Development
DBE	Department of Basic Education
DHET	Department of Higher Education and Training
DoE	Department of Education
DTDC	District Teacher Development Centre
ESD	Education for Sustainable Education
FET	Further Education and Training
HEI	Higher Education Institutions
ICT	Information and Communication Technology
IQMS	Integrated Quality Management System
ISPFTEd	Integrated Strategic Planning Framework for Teacher Education and Development
NCS	National Curriculum Statements
NEEP-GET	National Environmental Education Programme for General Education and Training
NGO	Non-Governmental Organisations
NS	Natural Sciences
NSC	National Senior Certificate
NWPA	North West Provincial Assessment
OBE	Outcomes Based Education
OECD	Organisation for Economic Co-operation and Development
PCK	Pedagogical Content Knowledge
PED	Provincial Education Departments
PGCE	Postgraduate Certificate in Education
PLC	Professional Learning Communities

POA	Programme of Assessment
PSF	Professional Support Forum
PTDI	Provincial Teacher Development Institutes
SACE	South African Council for Educators
UK	United Kingdoms
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USA	United States of America
WESSA	Wildlife and Environment Society of South Africa
WWF	World Wide Fund for Nature

CHAPTER 1: INTRODUCTION AND OVERVIEW OF THE STUDY

1.1.Introductory overview

This chapter introduces the focus of the research and also provides background to the study. A brief introduction to the research context is presented in order to outline the characteristics of the settings under which the study was conducted. The chapter also introduces the research question and goals, and finally outlines the content of each of the chapters to follow.

1.2. Background and rationale of the study

Curriculum change is not something unique to South Africa; it occurs internationally on an on-going basis and reflects the changes that are taking place in society (Moodley, 2013). Since the end of Apartheid in 1994, South Africa has gone through several changes in its education system (*ibid*). The outcomes based education (OBE) was introduced in 1997. This national curriculum, which came to be known as Curriculum 2005 (C2005), presented South African educators with a challenging and significant paradigm shift (Makhwathana, 2007). A review of C2005 found that its implementation had a number of issues which included a curriculum with a distorted structure, lack of alignment between curriculum and assessment policy, insufficient professional development and training for educators, to mention a few (South Africa. Organisation for Economic Co-operation and Development [OECD], 2008). This resulted in a number of curricular reviews, leading to several versions of the National Curriculum Statement (NCS) – which came into place in 2002, and the most recent Curriculum and Assessment Policy Statements (CAPS) (Johnson, Dempster & Hugo, 2015). CAPS was developed in 2010 and it brought a few significant changes into the schooling landscape (O'Donoghue, 2013). CAPS was first implemented in 2012 in the Foundation Phase (Grades 1 -3) and FET Grade 10; thereafter in the Intermediate Phase (Grades 4 - 6) and FET Grade 11 in 2013, and in the Senior Phase (Grade 7 to 9) and Grade 12 in 2014. CAPS has introduced a curriculum which is strongly content-referenced and is committed to active and critical approaches to learning, and to environment content in several subjects (Lotz-Sisitka, 2011).

Peden (2008) states that prior to 1994, environmental education was mainly the focus of environmental non-governmental organizations (NGOs) and universities, but since then environmental content has been integrated into the formal school curriculum both in principle and as a theme to be included in all subjects. There is evidence of the integration of environmental education in the National Curriculum Statement. One of the principles upon

which the National Curriculum Statement is based is that of “human rights, inclusivity, environmental and social justice” (South Africa. Department of Basic Education [DBE], 2011, p. 10). More specifically, in the Senior Phase Natural Sciences it is stated that “learners should be able to have a grasp on scientific, technological and environmental knowledge and be able to apply it in new contexts.” (South Africa. DBE, 2011, p. 10). The integration of environmental education in the school’s curriculum is of significance as it addresses the global environmental issues by preparing and actively involving learners in the planning of improving and protecting the environment for the future (UNESCO 1992). Teaching environment and sustainability content in schools is relevant to the principle in the White Paper on Education and Training. The White Paper (South Africa, 1995) indicates that in order to create South African citizens who are knowledgeable about and active in environmental issues, environmental education must be a vital component of all educational programmes.

With the changing curriculum and issues which are related to the environment, teachers dealing with environmental content need to possess knowledge and skills to implement environmental education approaches which will enable them to attain the goals of environmental education. Lotz-Sisitka (2011) mentioned that successful implementation of CAPS requires that teachers attain necessary subject content knowledge and pedagogical content knowledge (PCK) skills for integration of environment and sustainability concerns into the South African National Curriculum. Teachers are also required to have skills to use pedagogical approaches that support environmental education and are different from the traditional approaches. However, it has been argued that the implementation of CAPS lacks systemic coherence due to teachers’ lack of subject knowledge, poor pedagogy, and assessment practice, in relation to environmental education (Songqwaru, 2012). Research has shown that teachers are struggling to successfully integrate environmental education in their teaching (Fleming, 2009; Tshiningayamwe, 2011; Songqwaru, 2012; Chitsiga, 2016).

The national skills studies for the environmental sector also show that there is inadequate knowledge of the environment and sustainability among teachers to lay the foundation for further environmental learning and career path development for youth in South Africa. The studies also pointed out the need to develop South African teachers’ knowledge and pedagogical knowledge to teach environmental and sustainable development content (Lotz-Sisitka, 2011). During the contextual profiling for this study, teachers from a school in Mahikeng, teaching Life Sciences in FET (Grade 10 to 12) were interviewed and confirmed the above to be true. They both identified topics on biodiversity and animals, biodiversity and

life, biomes and biosphere, to mention a few, as topics they do not enjoy teaching. Reasons are that they do not know how to make these topics real to learners, and are not able to do practical or field work (Moyo and Ntoagae, personal communication, February 17, 2017). The subject advisor for Natural Sciences also indicated that teachers are struggling in teaching biodiversity topics in Grade 7 (Senna, personal communication, August 09, 2017).

Furthermore, there are concerns around professional teacher development and training. Du Toit and Sguazzin (2000) explained that studies have revealed that the ‘cascade model’ which is used to transfer curriculum transformation to teachers in order to prepare them to implement a new curriculum is not adequate to meet the demands of a changing curriculum. There has been criticism of the once-off in-service workshops, which are predominant in many teacher training programs, on the grounds that they do not offer continuous meaningful support and training to teachers to prepare them for new curriculum changes (*ibid*). Teachers interviewed during the contextual profiling voiced their discontent with the once-off CAPS implementation workshop they attended for Life Sciences. They did not find the workshop useful because it was not focusing on content, but rather the curriculum document was read to them without any engagement (Moyo and Ntoagae, personal communication, February 17, 2017). Another concern is that of professional support workshops which are initiated and run by the Department of Basic Education (local area office). These workshops are supposed to be focusing on subject specific content, but instead the focus is always on exams, improving results; subject content is never discussed (Moyo and Ntoagae, personal communication, February 17, 2017).

The continuing professional development of teachers is now a priority in many countries around the world, including South Africa. In South Africa, there are a variety of mechanisms used to address teachers’ development needs; these include the Integrated Quality Monitoring System (IQMS) and programmes for continuing professional development. The Department of Basic Education (South Africa. DBE, 2011b) emphasizes that for professional development to be considered effective, it must have a sustainable, positive impact on the quality of teaching and learning, with activities that take into account prior knowledge and experiences; engage teachers in active learning; are relevant and context related; promote interaction and collaboration; are teacher-driven and promote ownership in learning; and promote critical and systematic reflection.

The Integrated Strategic Planning Framework for Teacher Education and Development (ISPFTED), which was implemented in 2011, called for the establishment of Professional Learning Communities (PLCs) as a mechanism that promotes Continuing Teacher Professional Development (CTPD). Professional Learning Communities are networks of teachers which promote the learning of teachers within a context of a community. A detailed explanation of what PLCs are is given in Chapter 2. The ISPFTED is aligned to other national policies which are aimed at improving professionalism, teaching skills, and teachers' subject knowledge throughout their careers (South Africa. DBE, 2011b). The study therefore seeks to explore how the Professional Support Forum (PSF), as an example of a PLC, can improve teaching skills and teachers' subject knowledge in the teaching of Grade 8 Natural Sciences' environmental content.

My interest in exploring how professional learning communities can contribute to the development of teachers' valued beings and capabilities emerged while I was working in the environmental sector. I was a Natural and Physical Sciences teacher before I resigned and worked as a biodiversity officer. During those years I came across environmental education, and I saw it as an opportunity to link my passion for teaching and the environment. I learned so much in my new job as a biodiversity officer that I decided to go back into teaching and implement some of the things in the formal curriculum. When I started again as a Natural Sciences teacher, I realized that it would require more than just my efforts as a teacher to achieve this. There was insufficient support to help me integrate environmental issues in the formal school curriculum. In trying to find a way of using an environmentally directed teaching and learning approach in my classroom, I decided to explore how teachers could be supported and developed professionally to teach environmental content in Natural Sciences. I believe that teacher professional development should be done in such a way that teachers can have a say on what kind of development would meet their needs and how. This is why I developed interest in working with the capability approach to understand teachers' valued beings and doings in their professional development. In the capability approach, capability refers to what people are effectively able to be and do, while valued beings and doings refer to various things people may value being or doing (see section 2.7). The term valued beings and doings refers to valued functionings, and the two have been used interchangeably in the study.

1.3.Aim of the study

The aim of this study is to explore and understand teachers' valued functionings in teaching environmental content in Natural Sciences, and in belonging to a professional learning community. This study attempts to also understand what conversion factors enable or constrain teachers' functioning in the classroom and in the Professional Support Forum. Conversion factors are factors that influence the relationship between a functioning and the achievement thereof (see section 2.7 for detailed explanation). The findings of this study would be of interest to subject advisors and those involved with teacher professional development with a framework of professional learning communities, particularly in Natural Sciences teacher professional development.

Research question:

How can Professional Learning Communities (PLCs) contribute to the development of teachers' capabilities and achievement of valued functionings related to teaching environmental content knowledge in the Living and Life strand in Grade 8 Natural Sciences?

In order to answer this research question, the following sub-questions were formulated:

1. How is environmental content knowledge in the Life and Living strand in Natural Sciences taught in the classroom?
2. What functionings do teachers value most in teaching environmental content knowledge in the Life and Living strand in grade 8 Natural Sciences and what conversion factors are associated with these functionings?
3. What are teachers' valued functionings in the Professional Support Forum and what conversions factors in the Professional Support Forum are associated with these functionings?
4. How can the Professional Support Forum provide teachers with experiences that develop the knowledge and skills they need to engage learners when they teach environmental content in Life and Living strand in grade 8 Natural Sciences?

1.4. Research sites and participants and context of the study

The study was undertaken in Mahikeng, the capital town of the North West province. The population of the study was a group of Natural Sciences teachers from the Mahikeng sub-district in Ngaka Modiri Molema District. The district has 152 schools, which includes both public and independent primary and secondary schools. The research participants were 13 teachers who were part of the PSF meeting which was observed, and who also filled out the questionnaires. They were from 27 different schools situated in the Mahikeng sub-district. Their years of teaching experience in Natural Sciences ranged between 3 months to 18 years. Of the 13 teachers, five of them had B.Ed degrees, four had B.Sc degrees, one an M.Sc degree, and three had Diplomas in Higher Education. The two teachers who were willing to be observed in their classrooms were from a school situated in one of the rural areas of Mahikeng sub-district. The school falls under quintile 2, meaning that it is a no-fee school. The school receives funding from the Provincial Education Department. Learner enrolment in the school is about 1045, with 36 teachers. The ratio of teachers to learners is approximately 1: 55. The home language of the majority of learners and teachers is Setswana, and English is the medium of instruction in the school. One of the teachers (referred to as T1) has 23 years teaching experience, holds a Diploma in Biology teaching, and has been teaching Natural Sciences for 2 years. The second teacher (referred to as T2) hold a BHSc (Biomedical Sciences) degree, and is an inexperienced teacher with only a year in the teaching profession and a few months in teaching Natural Sciences.

1.5.Overview of the study

This study comprises of five other chapters following this one, and a summary of each is given. The following chapter (**Chapter 2**) is a review of the literature relevant to this study. It provides a conceptual and theoretical context of the study. The chapter starts by exploring the introduction of environmental education in South Africa. Then it further looks at the environmental themes in the Natural Sciences CAPS document. The chapter also explores literature pertaining to teacher professional development and professional learning communities. Finally, it concludes with a discussion of the capability approach which is the conceptual framework of the study.

Chapter 3 describes the research methodology and orientation that underpins this study. The chapter starts by discussing the interpretive case study approach of the study and the data generating methods used. It further explains how the data were managed, analysed and interpreted. The chapter concludes by discussing the issues of validity and trustworthiness, ethics, and limitations.

Chapter 4 presents the data generated from document analysis, classroom observations, PSF observation, interviews and questionnaires. The chapter begins with an analysis of the NS CAPS document, and teachers' lesson plans. This is followed by a description of how the teachers taught environmental content in their classrooms. The analysis addressed sub-question one of the study. The chapter further presents teachers' valued functionings in teaching environmental content, and the related conversion factors in response to sub-question two of the study. Finally the chapter presents data on teachers valued beings and doings in the PSF.

Chapter 5 presents a detailed analysis of teachers' valued functionings presented in Chapter 4, using the capability approach theoretical framework. The chapter discusses the conversion factors related to teachers' valued functionings, and addresses sub-questions two, three and four of the study.

Chapter 6 discusses the research findings described in Chapter 4 and Chapter 5 using a set of analytical statements. The analytical statements address the research questions outlined in Chapter 1. It also uses the study's conceptual and theoretical framework presented in Chapter 2. Finally the chapter summarises the study and provides recommendations from the study and recommendations for further research.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter provides literature on environmental education and teacher professional development. The chapter highlights a brief history of the development of environmental education in South Africa, Pedagogic approaches in environmental education, incorporation of environmental education into the school curriculum and an overview of what the Natural Sciences Curriculum and Assessment Policy Statement (CAPS) document entails. The chapter further discusses teacher professional development, and draws on research on professional learning communities. Finally, the chapter details the Capability Approach theory which forms the conceptual framework of the study.

2.2. Environmental education in South Africa

Focus on environmental issues came about in the 1960s in response to environmental issues developing at the time, which led to international environmental conferences and summits for education that would take a forefront in the protection of the environment (Chitsiga, 2016). In June 1972, the UN held the first conference in Stockholm, which focused on the link between humans and the environment. Two decades following the conference, The Rio Summit (UNCED) was held to deliberate once again the relationship between humans and the environment. This Summit expounded on the relationship between environment and development, and a global plan was developed in Agenda 21: Programme of Action for Sustainable Development (Lotz-Sisitka, 2004). According to UNESCO (1992), Agenda 21 was a major influence of the environmental education in schools. It was through it that Education for Sustainable Development was proposed as a multi-disciplinary approach to school curricula which would acknowledge environmental approaches to teaching and learning that would actively involve students in the planning of environmental activities, to improve and protect the environment for the future.

In South Africa, the White Paper on Education and Training (South Africa, 1995) was released and became the driver for the inclusion of environmental education in the school curriculum. A principle in the White Paper (1995) notes that: “Environmental education, involving an interdisciplinary, integrated and active approach to learning, must be a vital element of all levels and programmes of the education and training system, in order to create environmentally literate and active citizens and ensure that all South Africans, present and future, enjoy a decent quality of life through the sustainable use of resources” (p. 17).

Prior to 1994, environmental education was predominantly led by non-governmental organisations (NGOs) and some universities, but it has since been integrated in the formal school curriculum both in principle and as a theme to be included in all subjects (Peden, 2008). The National Curriculum Statements were used to promote sustainable development concepts, actions and principles (Lotz-Sisitka & O'Donoghue, 2007). In the National Curriculum Statements, the principles of a healthy environment, social and environmental justice as well as human rights were integrated into teaching and learning activities, in both primary and secondary schools. Featured across the curriculum were the concepts of and values like sustainability, respect for the environment, responsibility and participation (Rosenberg, 2008). In 2012, the Curriculum Assessment Policy Statement (CAPS) was implemented and it has introduced a curriculum which is strongly content-referenced and is committed to learning approaches which are active and critical, and to environment and sustainability content (Lotz-Sisitka., 2011).

In literature, the concept of environmental education has been used interchangeably with education for sustainable development, sustainability education, learning for sustainability, environment and sustainability. However, there have been debates around the concept of sustainable development. Peden (2008) says the concept “broadly includes three pillars of development: environment, economy and society” (p. 14); and by 1996 the concept had more than 300 definitions. He says that the concept has been interpreted in numerous ways and the focus is largely on economic rather than environmental sustainability (Peden, 2008). This view is echoed by Robottom (2007) who claims that as sustainable development is being taken up in political platforms, the focus on the environment is often diminished and is completely taken out of the picture. Robottom (2007) further argues that the concept of sustainable development does not challenge established practice but instead suggests a continuation of what people value. He argues that the concept is shifting the emphasis away from the natural environment and is more focussed on the political, social and economic environment. Reid and Scott (2006) describe the tension between environmental and education for sustainable development (ESD) as mainly a tension between social justice and environmental protection. Concerns emerged for some educators and scientists that the shift away from the natural sciences inevitably leads to a diminished knowledge and a shallow understanding of environmental issues (Peden, 2008). Rosenberg (2004) also observed that South African teachers do not have strong knowledge of natural sciences, and this leads to the exclusion of the natural environment in environmental education.

In integrating the key principles of Education for Sustainable Development into the South African school curriculum – Curriculum 2005 (C2005), few programmes were established. The Learning for Sustainability Project, which was a pilot project with the aim of supporting the implementation of environmental education in the formal education system in South Africa, was developed in 1996. It was implemented in 1997, the year in which curriculum 2005 (C2005) was introduced in the country (Lotz-Sisitka & Janse van Rensburg, 2000). The project piloted a teacher professional development model that introduced the notion of environmental sustainability to teachers, and did so within the framework of Curriculum 2005. The Learning for Sustainability Project integrated environmental education in the curriculum through a three-pillared approach which consisted of teacher professional development, curriculum development and development of materials (Janse van Rensburg & Lotz-Sisitka, 2000). The project activities involved teachers through cluster meetings and field trips, where they collaboratively explored local environment issues and related resource materials. Teachers were also encouraged to deliberate on what environmental sustainability meant in their context, and design classroom activities to introduce learners to local issues related to environmental sustainability (Janse van Rensburg & Lotz-Sisitka, 2000).

In 2002, a National Environmental Education Programme for General Education and Training (NEEP-GET) was established, building on the Learning for Sustainability project (Lotz-Sisitka, 2011). According to Lotz-Sisitka (*ibid*) the NEEP-GET was oriented towards building system capacity for implementing the key principle of the national curriculum statement (NCS). This was the principle of creating awareness of the relationship between human rights, a healthy environment, social justice and inclusivity. The NEEP-GET supported the emergence of Education for Sustainable Development Strategy in South Africa, but its piloting models were more focused on the professional development of subject advisors at district level than on formal teacher education programmes.

Another programme which was established was the Eco-schools. Eco-schools in South Africa were launched in 2003 by the Wildlife and Environment Society of South Africa (WESSA) and the World Wide Fund for Nature (WWF) South Africa (Rosenberg, 2008). The programme provides teachers with tools and resources useful for the integration of environment and sustainability issues such as biodiversity, resources management, health and nutrition into the school curriculum (Lotz-Sisitka, 2011). She (*ibid*) argues that both these programmes – the NEEP-GET and the Eco-Schools have not been able to deliver a sustainable system of teacher professional development for environment and sustainability education in South Africa. She

notes that while many examples of good practices of integrating environment and sustainability concerns into the curriculum exist in schools (via the Eco-Schools Programme annual portfolios and on-going school-based practices), not much was achieved to ensure that there is a consistent and coherent integration of environment and sustainability into teacher education.

Another programme, Fundisa for Change, was established in 2011. The programme was a response to the failure of numerous efforts to make systematic impact in strengthening environment and sustainability in teacher education (Lotz-Sisitka, 2011). It was formed by partners from higher education, parastatals, government, and NGOs. The initial focus of the programme was on developing materials for an environmental education professional development programme for teachers that is aligned with CAPS and teacher development policy (Songqwaru, 2012). In order to achieve this, the Fundisa for Change did a review of the CAPS curriculum and identified a wide range of environment and sustainability content and concepts in different subjects and developed materials for teachers to strengthen and expand their basic knowledge of strategies used in teaching and assessing those environmental topics (Lotz-Sisitka, 2011). Environment and sustainability knowledge is still new and thus requires new content matter and new pedagogical approaches (Fundisa for Change, 2013).

2.3. Pedagogic approaches in environmental education

“Environmental issues are complex and they are changing all the time, therefore there is a need for methodological shifts in implementing environmental education” (Tshiningayamwe, 2011, p. 32). As mentioned earlier, literature on environmental education defines it in multiple ways, but for the purpose of this study and the context in which the study is situated environmental education is the term used. Environmental education is understood to be a collaboration of content and pedagogy that engages students in a study of the environment to “encourage behaviour change and action” (Thomas, 2005, p. 108). This definition speaks to one of the aspects that the study seeks to explore; which is teachers’ environmental content knowledge and the pedagogical approaches used in mediating that knowledge in their classrooms. It is thus a combination of content knowledge and pedagogy. The fundamental pedagogical methods in environmental education include: hands-on-activities, relevant subject content, and topics that engage students and promote participation (Riordan & Klein, 2010). Riordan and Klein (*ibid*) further note that the pedagogy of environmental education is based on a view of teaching as a “creative and dynamic process in which pupils and teachers engaged together in a search for solutions to environmental problems” (p. 2). However, teachers also need to develop skills to

support learners in this search. Robottom (1987, cited in Riordan & Klein, 2010) emphasises that teachers' professional development should promote pedagogical approaches which differ from traditional approaches, to support teachers in environmental education. These include active investigation of local issues, and robust participation – with learners – in activities around environmental improvement. Rosenberg, O'Donoghue and Olvitt (2008) also introduced pedagogical approaches that support change-oriented learning towards better environmental sustainability practices. The approaches, with examples of methods, are given below:

- **Information transfer methods:** these methods include awareness and social marketing campaigns, talks and presentations, demonstrations and experiments, guided questioning, fieldtrips, excursions and exchange visits, games and quizzes.
- **Experiential methods:** solitaire, interpretive trails, role play, music, poetry and visual art, values clarifications, working with camera.
- **Investigative methods:** participatory methods, fieldwork and collaborative research, case studies, exploring indigenous ways of knowing,
- **Learning-by-doing methods:** Action research and community problem solving, projects and practical actions, and stewardship agreements.
- **Deliberative Methods:** dialogic cartoons and programmes, media analysis, social learning methods, story methods, drama and theatre for development, scenario planning and backward mapping.

Rosenberg et al. (2008) further note that using a range of teaching methods and processes increases the chances of all learners learning. They further say learners have different learning styles, and therefore they will learn and respond better to processes that fit how they learn. Additionally, a variety of teaching methods allows for a variety of educational purposes and outcomes to be addressed.

According to UNESCO (2012), the ability of teachers to use a wide range of pedagogical approaches is critical for working with learners' individual abilities and diverse needs. Their argument is the same as that of Rosenberg et al. (2008); that learners learn in different ways, therefore teachers need to employ pedagogies that cater for every learners' needs (UNESCO, 2012). The Natural Sciences curriculum also emphasises that learners should acquire and apply knowledge in ways that are practical for them (South Africa. DBE, 2011). Therefore, teachers need to teach in ways that will enable learners to apply what they learn. The next section

discusses what the NS CAPS curriculum entails in terms of environmental content, and the knowledge and cognitive skills that learners need to acquire.

2.4. Environmental themes in the Natural Sciences CAPS curriculum

The Natural Sciences CAPS curriculum is the official document stipulated by the Department of Basic Education (DBE), which is used by all teachers in the teaching of Natural Sciences. The CAPS curriculum (South Africa. DBE, 2011) “gives expression to the knowledge, skills and values worth learning in South African schools. This curriculum aims to ensure that children acquire and apply knowledge and skills in ways that are meaningful to their own lives. In this regard, the curriculum promotes knowledge in local contexts while being sensitive to global imperatives” (p. 4). In the light of this, CAPS is based on the following principles:

- Social transformation: ensuring that the educational imbalances of the past are redressed, and that equal educational opportunities are provided for all sections of the population;
- Active and critical learning: encouraging an active and critical approach to learning, rather than rote and uncritical learning of given truths;
- High knowledge and high skills: the minimum standards of knowledge and skills to be achieved at each grade are specified and set high, achievable standards in all subjects;
- Progression: content and context of each grade shows progression from simple to complex;
- **Human rights, inclusivity, environmental and social justice: infusing the principles and practices of social and environmental justice and human rights as defined in the Constitution of the Republic of South Africa** [my emphasis]. The CAPS curriculum is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors;
- Valuing indigenous knowledge systems: acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution; and
- Credibility and efficiency: providing an education that is comparable in quality, breadth and depth to that of any other country.

According to the Department of Basic Education (South Africa. DBE, 2011), among many other aims, the National Curriculum Statement aims to produce learners that are able to:

- Use science and technology effectively and critically showing responsibility towards the environment and the health of others; and
- Demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation.

The CAPS document for Natural Sciences emphasizes that in teaching and learning Science, a variety of teaching and learning approaches should be used to promote an understanding of:

- Science as a discipline for enjoyment and curiosity about the world and natural phenomena
- The history of Science and the relationship between Natural Sciences and other subjects
- The different cultural contexts in which indigenous knowledge systems have developed
- The contribution of Science to social justice and societal development
- **The need for using scientific knowledge responsibly in the interest of ourselves, of society and the environment** [my emphasis]
- The practical and ethical consequences of decisions based on Science (South Africa. DBE, 2011, p. 8).

At the Senior Phase level, Natural Sciences sets the foundation of further studies in more specific science disciplines such as Life Sciences, Physical Sciences, Earth Sciences or Agricultural Sciences. It prepares learners for involvement in a democratic society that values human rights and **promotes responsibility towards the environment** [my emphasis] (South Africa. DBE, 2011, p. 9).

The subject is organised into four Knowledge Strands, which are used as a tool for organising its content (South Africa. DBE, 2011, p. 9). These Knowledge Strands are: Life and Living, Matter and Material, Energy and Change, and Planet Earth and Beyond. Each Knowledge Strand is developed progressively across the Senior Phase, from Grade 7 to 9. When teaching Natural Sciences, it is important to help learners make links with related topics for them to attain a thorough understanding of the nature of and the connectedness in Natural Sciences (South Africa. DBE, 2011).

The focus of this study is on the Life and Living strand, which has the following topics and sub-topics:

1. Photosynthesis and respiration.

2. Interactions and interdependence within the environment:

- Introduction to ecology,
- Ecosystems,
- Feeding relationships,
- Energy flow: food chains and food webs,
- Balance in the ecosystem,
- Adaptations,
- Conservation of the ecosystem

The focus of this study is specifically on the topic of interactions and interdependence within the environment as this topic provides teachers with opportunities to expound on environment and sustainability education. The topic is allocated six weeks of teaching on the work-schedule.

In terms of assessment, the CAPS document does not specify how the topics should be assessed. It says that the time spent on each topic should serve as a guideline for weighting of marks; and the purpose is to ensure that all topics are assessed (South Africa. DBE, 2011, p. 86). The CAPS document (South Africa. DBE, 2011) further states that assessments in Natural Sciences should cater for a variety of cognitive levels and learners' abilities and should be carefully designed to cover the content of the subject as well as the range of major skills. Table 2.1 below shows the cognitive levels for the assessment of content in Grades 7, 8 and 9.

Table 2.1: Cognitive levels for the assessment of content in the senior phase Natural Sciences. (South Africa. DBE, 2011, p. 87)

Setting tests and tasks for different cognitive levels	Knowing science	Understanding science	Applying scientific knowledge	Evaluating, analysing, synthesising scientific knowledge
Percentages indicating the proportion of low, middle and high order questions in tasks, tests and exams.	Low order questions 40 %	Middle order questions 45 %		High order questions 15 %
Useful verbs to use when setting questions	State Name Label List Define Describe And others...	Explain Compare Rearrange Illustrate Give an example Calculate Make a generalisation And others...	Predict Apply Use knowledge to demonstrate Solve Implement Judge And others...	Select Differentiate Analyse Infer Suggest a reason Interpret Discuss Categorise And others ...

In the curriculum document, clear guidelines are given as to what activities learners should be given and the skills they should acquire. Learners must be able to:

- evaluate the impacts of various factors (such as loss of habitat, loss of species, and change of weather or climate) on the ecosystem,
- Read and write about how animals are adapted to live in extreme environments,
- Write about the importance of maintaining biodiversity and sustainable use of natural resources, and
- Research on the irresponsible human practices (such as inappropriate waste disposal) and their impact on the ecosystem, and suggest possible solutions (South Africa. DBE, 2011, p. 38).

Natural Sciences has three specific aims:

- **Specific Aim 1: Doing Science**

Learners should be able to complete investigations, analyse problems and use practical processes and skills in evaluating solutions.

- **Specific Aim 2: Knowing the subject content and making connections**

Learners should have a grasp of scientific, technological and environmental knowledge and be able to apply it in new contexts.

- **Specific Aim 3: understanding the uses of Science**

Learners should understand the uses of Natural Sciences and indigenous knowledge in society and the environment (South Africa. DBE, 2011).

The Natural Sciences CAPS curriculum also describes the cognitive and practical skills that learners should develop and apply; these are: accessing and recalling information, observing, comparing, measuring, sorting and classifying, identifying problems and issues, raising questions, predicting, hypothesizing, planning and doing investigations, recording and interpreting information, and communicating. In light of this study, one could argue that for learners to be able to achieve the above stated cognitive and practical skills when engaging with environment and sustainability content knowledge and issues, teachers need to have the knowledge and the ability to teach and assess environmental topics. This is why teacher training and development in environmental education is critical.

2.5. Teacher professional development

Teacher professional development is a wide-spread and thriving research and development arena throughout the world. When a new curriculum is introduced, there is an expectation that teachers would undergo an intensive and extensive professional development to prepare them for its implementation (Songqwaru, 2012). Professional development includes many concepts such as staff development, in-service training, professional learning, or continuing education (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009). Mokhele and Jita (2010) view teacher professional development as involving systematic efforts to bring about a change in classroom practices of teachers, in their attitudes and beliefs, and in the learning outcomes of learners. For this study, the concept of professional development used is by Evans (2002) who defines professional development as “all types of professional learning undertaken by teachers beyond the point of initial training, the concomitant skills learnt and developed in these learning processes, and changes in approaches to practice resulting from them” (p. 134).

Different authors (Darling-Hammond & McLaughlin, 1995; Du Toit & Sguazzin, 2000; Hinde, 2003) have noted that effective professional development should offer teachers opportunities to collaborate with each other, and to engage with ideas and materials. The focus should be on building teachers’ skills, competencies and attitudes, and not just a mere transfer of

information. They further argue that professional development should also provide a foundation for inquiry, reflection, and experimentation for inquiry, and take into account teachers' contexts of teaching and their prior knowledge and experiences. Another characteristic of professional development is that it should take explicit account of classroom practices, and make connections to classroom teaching and students' learning. Du Toit and Sguazzin (2000) argue that teachers' self-determined professional development needs and goals should guide professional development, and that teachers should be given opportunities to grow according to their needs. This is supported by Hinde (2003) who noted that professional development should ensure that there is a balance between the interest of teachers and the interests of institutions.

Having highlighted what the different authors say about what teacher professional development should entail, one looks at what happened in South Africa in terms of teachers' professional development during the introduction of CAPS. When CAPS was introduced, the education authorities (South Africa. DBE, 2010) stated: "we will intensify teacher development to prepare educators for the implementation of the Curriculum and Assessment Policy Statement and pay special attention to the training of principals, particularly those in underperforming schools" (no page number). Subject Advisors from all the nine provinces were offered training. This was done in order to prepare for the introduction of CAPS and to ensure that other stakeholders were similarly knowledgeable on the implications of the introduction of CAPS. More than 3000 Further Education and Training band (Grade 10 – 12) officials and more than 1000 officials in the General Education and Training (Grade R – 9) attended the training to receive orientation in 2012. The training did not include teachers; teachers were trained from 2012 to 2014 as the curriculum was implemented in different grades. The first implementation was in Grades 1, 2, 3 and 10 in 2012; thereafter Grades 4 to 6 in 2013; and Grades 7, 8, 9 and 12 in 2014 (Moodley, 2013).

Although a lot of money and effort has been invested towards teacher development, Bertram (2011) noted that the quality of education in South Africa has not improved. Hargreaves (1995, as cited in Songqwaru, 2012) acknowledges that teacher training and development is of utmost importance to educational reform. However, he notes that literature on professional development has a lot of critiques regarding many teacher training programmes which offer once-off in-service workshops. He argues that these workshops expose teachers to the new curriculum changes without continual meaningful support and training, as a result they do not have a noticeable impact on improving teachers' current practices. Darling-Hammond (2008)

concur with another author, Moon (2001) that once off trainings and workshops do not have an impact on teachers' teaching practices. This was also a challenge with the implementation of CAPS. Research shows that some teachers felt that they were inadequately trained to implement CAPS (Songqwaru, 2012; Moodley, 2013). Moodley (2013) noted that teachers voiced their concerns that the facilitators did not deal with the issues they experience in classrooms in a practical way. Tshiningayamwe (2016a) also noted that the CAPS training used the same cascading model which was used when Curriculum 2005 was introduced to teachers. She further noted that the cascading model has proven to be an ineffective model for professional development.

Mokhele and Jita (2010) argued that for professional development programmes to be effective, they need to have personal meaning to teachers who are participating in them, and should be relevant to their needs; they concluded that teacher development programmes should be continuous and aligned with teachers' personal needs and motivations. Janse van Rensburg and Mhoney (2000) also criticised the model of once-off trainings, they stated "short, once-off teacher development sessions are a waste of time in addressing the kinds of conceptual learning that our context seems to require" (p. 57). Songqwaru (2012) and Moodley (2013) reported the same findings with the CAPS training workshops, and pointed out that teachers complained about the duration of the training, that the one-day workshop was too generic and not subject specific. Janse van Rensburg and Mhoney (2000) claimed that what was required was a process-oriented model for professional development. One such model, which was introduced out of concern that existing professional development models were inadequate, was the spiral model. The model was piloted by the Learning for Sustainability project staff between 1997 and 2000. Spiral models for teacher development required adequate structure and coherence (Janse van Rensburg & Lotz-Sisitka, 2000). The approach of the spiral models is a reflexive one, which involves teachers working together in meetings and then working away (in classrooms), and then reporting on practice back into on-going cluster meetings (*ibid*). Fundamental to the model is that professional development of teachers is an open-ended, continuous and reflective process (Janse van Rensburg & Lotz-Sisitka, 2000). Schudel (2012) noted that a spiral model approach to cluster-based teacher development could enhance reflexivity in processes involving active learning.

Some research has been conducted in South Africa which focused on professional development in the field of environmental education (Songqwaru, 2012; Chitsiga, 2016; Isaacs, 2016). Some of these researchers focussed specifically on teachers' knowledge of biodiversity. Although the

focus of my study is not on biodiversity, it is of relevance because biodiversity forms part of the Natural Sciences environmental topics. It is taught in Grade 7 and lays a conceptual foundation for the topic of interactions and interdependence in the environment; which is the topic of focus for my study in Grade 8. In the following section I briefly discuss literature on teachers' professional development on biodiversity knowledge and teaching.

2.5.1. Teachers' professional development on biodiversity

Some researchers have identified that in South Africa there is a lack of biodiversity knowledge amongst teachers, and the solution would be for teachers to participate in on-going professional activities to enhance their biodiversity knowledge (Lotz-Sisitka, 2011, Songqwaru 2012, Chitsiga, 2016, Isaacs, 2016, Tshiningayamwe, 2016). Lotz-Sisitka (2011), together with a team of members from different institutions who worked on a national case study on teacher development in Education for Sustainable Development, did a review of CAPS in different subjects and identified themes that have environmental content, namely: climate change, genetic diversity, population, taxonomy, human-environment relationships, ecosystem services, global warming and climate change. In Grade 8 Natural Sciences, the environmental themes are under the Life and Living strand (see section 2.4).

Another research was done by Songqwaru (2012) and was focused on how teachers can be supported to understand and work with the environment and sustainability content knowledge in the CAPS Grade 10 Life Sciences curriculum. Through her study, she found that Life Sciences teachers had gaps in environment and sustainability knowledge, and they were unfamiliar with some of the teaching approaches that could be used in teaching environment and sustainability content knowledge specified in Life Sciences. However, she found that through professional development programmes, teachers' confidence in teaching biodiversity developed. Chitsiga (2016) further noted a need for more on-going content workshops on environmental knowledge and exposure to active learning pedagogy. These findings suggest there is a need for teachers' professional development activities that will focus on enhancing teacher's biodiversity knowledge and teaching practice.

Isaacs (2016) explored what Grade 7 Natural Sciences teachers know, believe and say about biodiversity and the teaching of biodiversity. Her research showed that teachers' knowledge of biodiversity was mostly limited to what they accessed in the curriculum and textbooks; and she recommended that there is a need for teacher training and in-service teachers' training and support to shape a broader knowledge base for biodiversity.

Tshiningayamwe (2016b) noted that due to a lack of teachers' subject knowledge, poor pedagogy and assessment practice, the implementation of biodiversity-related elements lacks systemic coherence. She did a research on how Life Sciences teachers can be supported through professional learning communities as a potential approach to enhance their knowledge of biodiversity. The findings of her research indicated that for professional learning communities to be effective, "they need to support teachers' continuous learning by being sustained over time" (p. 48). The following sections discuss in detail the concept of professional learning communities.

2.6. Professional Learning Communities

There is no universal definition of a professional learning community (Stoll, Bolam, McMahon, Wellace & Thomas, 2006). There are different terms related to the concept of professional learning communities, including professional learning groups, collaborative learning communities, critical friends groups, communities of practice, study groups, teacher research collaboration, or professional networks, to name just a few (Hidden curriculum, 2014; Norman, Golian, & Hooker, 2015). Terms such as professional learning groups and critical friends are usually applied to smaller groups of teachers rather than to an entire school that uses small-group collaboration as a form of professional development (Hidden curriculum, 2014). While the term professional learning communities is defined by some educators in a very specific way, Dufour (2004) argues that "the term has been used so ubiquitously that it is in danger of losing all meaning" (p. 6). According to him, (*ibid*) the term professional learning community (PLC) should only be applied to schools in which there are specific strategies in place used by all teachers and school leaders. A number of authors, Stoll et al. (2006) agree that the concept of PLC means "a group of teachers sharing and critically interrogating their practice in an on-going, reflective, collaborative, inclusive, learning-oriented, growth-promoting way to support innovation and knowledge sharing" (p. 223). Fulton, Doerr and Britton (2010) argue that to be able to define the concept of PLC, there is a need to fully understand it. They further noted that in order to regard some activity as a PLC, each of the components in the term "professional learning communities" should be fulfilled. *Professional* means involving educators in their professional practice development; *learning* means focused on both the learning of the educators and the learning of their students; and *community* requires common vision, goals, purpose, and a shared sense of trust as well as collaborative work.

While there are quite a few definitions for PLC documented in the literature, there is a general agreement across definitions that a PLC emphasizes relationships, shares ideas, and develops

a strong culture committed to improved student learning. Stoll et al. (2006) emphasized that at the core of the concept is the notion of community, and that the focus is more on professional learning within a community, than just on individual teachers' professional learning. Further queries are raised about the concept. How inclusive is the PLC? According to Stoll et al. (2006), PLCs can operate at a number of different levels. PLCs can function in a school including teachers only or all staff in the school. PLCs can also involve many schools working together (*ibid*). PLCs can have teachers from different grades or subjects (Fulton et al., 2010) but Dawkins and Dickerson (2007) note that in programmes involving teachers from different grades and subjects, it is advisable to provide an infrastructure to link teachers within the same grade or subject. In contrast, in a multi-district project, Nelson and Slavit (2007) found that having combined mathematics or science PLCs made it challenging for the groups to focus on content. Similarly, Curry (2009) reported that in PLCs that had interdisciplinary membership, teachers did not choose to work on pedagogical content knowledge. In responding to whether PLCs are grade and subject specific, the Integrated Strategic Planning Framework for Teacher Education and Development (ISPFTED) (South Africa. DHET & DBE, 2011) indicates that the set-up of PLCs should respond to a need; the need can be to improve discipline in the class, to improve transition from one grade to another, or to focus on a particular subject. Therefore PLCs can be established for one grade or subject or include various grades and subjects. In this study, the PLC (also referred to as a PSF, professional support forum) involves Natural Sciences teachers from the same district but different schools. This will eliminate the limitation of working on environmental content knowledge in depth. The PSF, in this study, is viewed as professional learning community because it has some of the components of the characteristics of a PLC. The PSF engages teachers in the development of their professional practice; it is focussed on the learning of teachers; and it emphasizes collaboration and sharing of ideas among teachers (see section 2.6.2). In the next section the establishment of professional learning communities is discussed in detail.

2.6.1. Establishment of Professional Learning Communities

According to Thompson, Gregg and Niska (2004), rooted in the business sector, the concept of professional learning communities is based on Senge's belief that when members of an organisation learn, the entire organisation learns. Hord (2004) explains that Senge's description of learning organisations shifted into the educational environment. As Senge's paradigm was explored by educators and shared in educational journals, the label became learning communities (Hord, 2004). Through research conducted by Rosenholtz in 1989, the

organisational structure of a PLC in education theory began to develop (Tshiningayamwe, 2016). Rosenholtz found that teachers who were given opportunities for collegial collaboration learned from the experience and applied the knowledge gained into their classroom practices. Wood (2007) asserted that PLC settings allow teachers to see themselves as primary agents for change in teaching and learning.

In her research findings Hord (1997, cited in Underwood, 2007) identifies some benefits for teachers participating in successful PLCs including reduced isolation, increased commitment to goals, shared responsibility, increased knowledge of effective teaching practices, increased professional aspiration, and embedding systemic change. She further points out that PLCs encourage and support members to examine their practice, to reflect together on what works and why; and they offer opportunities for the collective construction and sharing of new knowledge. The following section discusses research that documents attributes of successful PLCs.

2.6.2. Characteristics of Professional Learning Communities

Professional learning communities appear to have five intertwined characteristics. These are:

- *Shared values and vision*

Stoll et al. (2006) suggest that a shared value base provides a framework for shared, collective, ethical decision making. A vision focused on student learning and shared values guides discussions and decisions about teaching and learning, while enabling individuals to act autonomously (Underwood, 2007).

- *Collective responsibility*

Collective responsibility helps to sustain commitment, puts peer pressure and accountability on teachers who do not do their fair share, and eases isolation (Stoll et al., 2006).

- *Supportive conditions and shared leadership*

In PLCs, supportive conditions exist when schools allow time for collaboration, empowering teachers, and reducing isolation (Hipp & Huffman, 2000). Underwood (2007) affirms from her research that in supportive PLCs, teachers reinforce each other in a climate that encourages observing students, sharing teaching strategies, trying new strategies, getting feedback, and redesigning curricula and methods of instruction. Shared leadership means that not only principals take the leadership roles, but teachers

as well. Teachers should be allowed to share responsibilities and make decisions (Hord, 2004).

- *Reflective professional inquiry*

Stoll et al. (2006) define professional inquiry as reflective dialogue, conversations about serious educational issues or problems involving the application of new knowledge. PLCs encourage teachers to open up their classroom through peer learning, team teaching, observations, and mentoring. By frequently examining one's practice through mutual observation and case analysis, joint planning and applying new ideas and information, members of a PLC gain a deeper understanding of educational processes (South Africa. DBE, 2015).

- *Group and individual learning is promoted*

All teachers are learners with their colleagues (Louis et al., 1995, as cited in Stoll et al., 2006). In PLCs, collective learning is evident, through collective knowledge creation, whereby the school learning community interacts, engages in serious dialogue and deliberates on information and data, interpreting it communally and distributing it among all teachers.

The Professional Support Forum (PSF) in this study has some of the characteristics of PLCs discussed above. Teachers, together with the subject advisor meet to have a shared value and vision on how they can improve learning and teaching in their classrooms. Professional inquiry is also part of the PSF sessions, where teachers engage with each other in conversations about educational issues, as well as planning together some activities for their learners. Although the PSF does not have all the characteristics of a PLC, it can be viewed as a PLC because it shares some of the characteristics of a PLC stated above.

Having presented the literature on the development and characteristics of PLCs, one can argue that PLCs hold promise in enhancing teachers' capabilities in teaching environmental content in the Natural Sciences curriculum. The next section discusses what the South African policy on teacher education and development says about Professional Learning Communities (PLCs).

2.6.3. The Integrated Strategic Planning Framework for Teacher Education and Development on PLCs

Although the PLC concept is considered to be an emerging policy concept in South Africa as indicated in the Integrated Strategic Planning Framework for Teacher Education and

Development, ISPFTED (South Africa. DHET & DBE, 2011), De Clerk and Phiri (2013) noted that clusters are in fact a South African version of PLCs. Emphasis in the ISPFTED is to promote Continuing Teacher Professional Development (CPTD) through support systems that promote the establishment of Professional Learning Communities (PLCs) to strengthen teacher professionalism (Tshiningayamwe, 2016b). There is a need for a strong conceptualisation of what PLCs are to avoid losing the power of the concept (South Africa. DBE, 2015). Tshiningayamwe (2016b) argues that the concept of a PLC is not adequately understood and is underdeveloped in the South African context. She further points out that although the policy documents on PLCs indicate clearly that teachers should be the central focus of PLC activities; the policy documents do not explicitly give the roles of teachers in PLCs. However, the DBE guideline for PLCs in South Africa (South Africa, DBE, 2015), outline the roles of teachers in PLCs. Furthermore, Tshiningayamwe (2016b) concurs with other authors that for PLCs to be effective and beneficial to teachers, PLCs should take into consideration and be aligned with teachers' valued beings and doings related to the teaching of biodiversity, in this case in the teaching of environmental content in Natural Sciences.

In this study, a professional support forum (PSF) is also a version of a PLC. In the North West province, PSFs have been in place for about 11 years. They are subject-based, initiated by the Department of Basic Education in the district and led by subject advisors. The Natural Sciences PSF that I am working with is structured in such a way that meetings are held once every term. The focus is mostly on subject content, which is decided by the subject advisor; and at other times administration work such as checking of teachers' files, learners' progress, schools' performance etc., is also included. Although these PSFs offer opportunities for teachers to engage in issues related to knowledge and teaching practices, there is still a need to model them according to what has been outlined in the ISPFTED about PLCs. The ISPFTED emphasises that teachers are to take leadership roles in PLCs, and take responsibility for and engage in professional learning in order to build their capacity and that of others (South Africa. DHET & DBE, 2011).

The ISPFTED views PLCs as the fundamental feature of identifying teachers' development needs, and as spaces for teachers' professional learning. It further says that teachers, both individually and collectively in their participation in the PLCs, must be at the heart of the system (South Africa. DHET & DBE, 2011). The hallmarks of PLCs, according to ISPFTED, are "open and democratic collaboration, conflict management and mutual problem-solving, which in turn promote the identification of specific individual and group developmental needs

along with actions aimed at addressing these needs” (South Africa. DHET & DBE, 2011, p. 80). Teachers are viewed as leaders who possess knowledge and are skilful, within the broader communities of learners, school managers, support staff and parents. The ISPFTED views PLCs as working at school level, and notes that although many PLCs already exists, they are still not as common in all schools and across the system as they should be. Therefore, districts, schools and teachers should be assisted in establishing where they do not exist (*ibid*).

The major responsibility of establishing and supporting PLCs lies with the provincial education departments and teachers. However, there are other stakeholders who have responsibilities in supporting PLCs. These include the DBE at provincial level, district officials, principals, school-based Heads of Departments (HODs), Higher Education Institutions (HEIs), and subject-based professional teacher associations and teachers unions. But ultimately, the key for success of any PLC lies with its participants, the teachers (South Africa. DBE, 2015). The key components of PLCs, namely; policy makers, school leaders, teachers and knowledge need to work together in order to change professional practise and improve learning outcomes (*ibid*). This is shown in Figure 2.1 below. For PLCs to be successful they require a shared vision on professional development in which all the above-mentioned components work together in order to change professional practice in ways that improve the learning, engagement and well-being of every South African learner.



Figure 2.1: Key components of Professional Learning Communities (adapted from South Africa. DBE, 2011, p. 8)

The DBE guideline for PLCs in South Africa (South Africa. DBE, 2015), outline the roles of the different role players in the PLCs. The following was extracted from the report (p. 8-10):

The Role of the Teacher

- Be motivated to actively engage in PLCs as a way to strengthen teacher professionalism and improve learning outcomes.
- Be open to contribute as well as to learn.
- To regard actively participating in PLCs as an integral part of teaching practice.
- To take up leadership roles in PLCs, such as facilitation, setting the agenda and defining outcomes.

Brodie and Borko (2016) note that since PLCs are new in South Africa, it can be argued that external leadership plays a key role. They further point out that however, if PLCs are to become widespread and truly professional, teachers are the ones who should conceptualise and lead

PLCs, with some support from the districts and other institutions such as universities. Coburn (2003) also notes that for PLCs to be sustained in schools and districts, key stakeholders and decision makers must view them as compatible with ongoing district priorities and existing programmes. The ISPFTED also gives the roles of other stakeholder involved in the PLCs:

The Role of the School Management Team is:

- To motivate teachers to engage in PLCs and create conditions wherein PLCs can thrive. However, the role of the principal is not to chair every PLC meeting.
- To guide the process to establish PLCs in the school. This includes informing teachers about PLCs, coordinating the formulation of expected outcomes and outputs and identifying people willing to take up leadership roles.
- To support PLCs by resource allocation, logistics and timetabling.

The Role of the Districts (DTDCs) is:

- To support PLCs with resources and expertise on facilitation skills, video analysis, development of teaching resources, the use of ICT [Information and Communication Technology].
- To highlight issues for discussion at provincial and national level.
- To function as a hub for exchanging PLC practices within the district.
- To create opportunities for follow up via PLCs in other professional development activities, such as workshops.
- To provide annual progress reports on the implementation of PLCs at provincial level.
- To develop synergies between PLCs and district subject committees.

The Role of the Provinces (PEDs/ PTDI) is:

- To provide an enabling environment for PLCs to be successful in the provinces.
- To provide external input to PLCs through subject advisors or trained mentor teachers.
- To provide support to PLCs through the development of expertise in the use of evidence-based assessments such as ANA [Annual National Assessment] and the NSC as well as support teachers to determine their own development trajectories.
- To monitor the implementation of PLCs in the province, recording inputs from the districts.
- To develop synergies between PLCs and provincial and district subject committees.
- To function as a hub for exchanging PLC practices within the province.

- To inform the national level on matters pertaining to the implementation of PLCs.
- To provide annual progress reports of implementation of PLCs at the national level.

What is highlighted also in the report is the role of the facilitator in the PLCs, which is regarded as crucial. The role is outlined below:

- The facilitator needs to have the ability to motivate, build trust, understand group dynamics, facilitate discussion and guard outcomes.
- The facilitator participates in PLC discussions, supports teachers by identifying gaps in their understanding and serves as a bridge to other PLCs. In this way, the facilitator provides content to the PLC, guides the process of inquiry and contributes to the community building process.
- The role of the facilitator is not to tell teachers what to do, to impose ideas or to judge people. Rather, a facilitator needs to support discussion and step in when it risks wandering off.
- In practice the role and responsibilities of the facilitator may vary. He or she can take more initiative when there are many new members in the PLC. Gradually, as members become more experienced, the facilitator's role may evolve into a less directive and more facilitative role.
- Facilitators should make sure that all perspectives are valued and that the perspective of the leader or facilitators does not get priority. PLCs in which the facilitator dares to question how things are done, are more likely to spark creativity, to remain responsive to emerging questions and shared interests and to be sustainable in the long run.
- Facilitators may need to take on a 'gatekeeper' role as well, recognizing pitfalls and providing corrective feedback. This can happen when members are not making adequate progress or fail to develop their portfolios. Playing both a supportive and regulating role can be difficult. The role of the facilitator should be described as explicitly as possible, including how far he or she should take up a 'gatekeeper' role in addition to the facilitator role.

Moreover, facilitator tasks can be taken up by different people. This discussion on what the role of the facilitator is, can best be organized when the PLC is established (South Africa. DBE, 2011, p. 12).

As professional development efforts increase across the world, knowledgeable and skilled facilitators are in high demand. Currently, many individuals who are selected to lead PLCs are

in the elementary stages of honing their leadership skills. There is need to prepare these novice facilitators to be proficient in working with teachers and supporting high-quality learning opportunities (Brodie & Borko, 2016). Additionally, Borko, Koellner and Jacobs (2014) noted that identifying the knowledge and practices necessary to be an effective leader in the PLCs is very important. What facilitators do to cultivate improvements in the classroom, which will result in learners' increased learning of complex subject matter, should be well understood. Many of the professional development leaders are or have been teachers. Although there may be some similarities between facilitating teacher learning and teaching lessons in a classroom, working with teachers (who are adult learners) is considerably different from teaching school learners, and as such, requires new knowledge and skill on the part of teacher leaders (Brodie & Borko, 2016). Research on the roles of facilitators and the knowledge and skills they require is only beginning, with much of this research located in the field of mathematics (Borko et al. 2014). In this study it emerged that the Natural Sciences subject advisor is the main facilitator. She has been the subject advisor and running the Natural Sciences PSF for 11 years. Some of her roles as the facilitator in the PSF include inducting new teachers, facilitating subject content training, and doing practical work with teachers. Outside of the PSF the subject advisor has other responsibilities such as school visits, monitoring the implementation of the curriculum, supporting teachers, and being accountable for performance in Natural Sciences (see section 4.5.1).

Activities in PLCs

Highlighted also in the DBE professional learning communities' guideline are activities that, according to the ISPFTED, are the main activities of PLCs. Participants are expected to:

- Analyse learner results of ANA [Annual National Assessment] and NSC, and link these results to teaching quality and members' development trajectories.
- Analyse, if there are any, significant differences in learning outcomes for male and female learners and take appropriate actions, if necessary.
- Discuss, critique and adapt the Curriculum and Assessment Policy Statements to their context.
- Discuss how to interpret and use curriculum support materials such as the workbooks distributed to teachers and schools by DBE;
- Collect and analyse data on learning in order to improve learning quality.
- Record and discuss video records of practice and other learning materials.

- Identify an area for improvement and use expertise within the PLC to help address that difficulty.
- Prepare lessons together and observe each other while teaching these lessons. Discuss the lessons afterwards in the PLC.
- Prepare a lesson for team teaching. This means that several teachers prepare, teach and assess a lesson together.
- Discuss how a certain piece of educational research could be carried out (South Africa. DBE, 2015, p. 13).

Though these are the suggested activities, each PLC will have its own vision and mission and define activities to achieve those. The guideline states that there is no fixed agenda for PLCs, and that the activities will vary according to the context of a PLC such as time available, the size of the group, the extent to which participants know each other and many other factors (South Africa. DBE, 2015). With all these activities, a crucial ingredient of the system is the need to make available quality time for teachers, to enable quality teacher development. The ISPFTED (South Africa. DHET & DBE, 2011) emphasises that time should be scheduled for teachers to participate in PLCs and to engage in quality teacher development. Loss of teaching time should be minimised although there are other factors, besides time, that contribute to difficulties of sustaining PLCs.

There are international studies that have highlighted some of the constraining factors to PLCs. For example, in North America and Europe, individualised practise has been identified as a constrain to collaborative learning (Dooner, Mandzuk & Clifton, 2008); while an Israeli study suggests that strong hierarchies of seniority among teachers as well as the central management of schools constrain the sustainability of PLCs (Schechter, 2012). Amongst other constraints, the following have been identified as well: teacher turnover and insufficient time for extended collaborative work (Boudett, City & Murnane, 2008).

PLCs arise in different contexts within different school cultures, which may enable and constrain their functioning in different ways (Brodie & Borko, 2016). In South Africa, similar constraints to the ones highlighted above, have been noted by researchers. Brodie and Borko (2016) pointed out some of the constraints in South African PLCs. They (*ibid*) highlighted two main constraints. The first one is the issue of hierarchies at school level – this is similar to what has been discovered in other countries. The second one is lack of trust among various levels of the system – government, principals, teachers, learners and parent – brought about by teaching

and learning contexts, such as low achievements of learners, which brings tension among the different stakeholders.

Another concern that emerged is that of how PLCs are conceptualised in the ISPFTED. PLCs are situated within a bureaucratic structure of district, provincial and national committees whose job is to establish and sustain the PLCs, make sure they do what they are supposed to do and report on their work to various structures. Brodie and Borko (2016) note that at a conference convened by the Department of Basic Education in 2014, where provincial and district officials learned how to implement PLCs, there were concerns that were voiced by the teacher delegates. The teachers noted that the language used to describe teachers' work and learning remained extremely prescriptive with regard to teacher development as a result of officials viewing PLCs as something that has to be done for teachers rather than by or with teachers. Brodie & Borko (2016) further point out that the performance management system for district and provincial officials pushes them into a 'tick box' mode, instead of supporting them to understand what the substantive possibilities for professional learning in communities might be and how these PLCs can create intellectual engagement for schools rather than become another exercise in prescription.

2.6.4. Professional Learning Communities in South Africa

In other countries and contexts, teacher clusters have a relatively longer history, and are also referred to as 'teacher communities of learning' or 'teacher networks' (Jita & Ndlalane, 2009). Although the teacher network approach has gained popularity in countries such as the United States of America (USA) and the United Kingdom (UK), there is no conclusive research on its usefulness in changing teachers' knowledge and practices (Adams, 2000). Research in the North American and European systems shows that there has been a long-established and widespread culture of individualised practice in schools which is not conducive to professional development and learning (Dooner, Mandzuk & Clifton, 2008). It has been pointed out that the development of PLCs in these countries has taken time and effort and has often required external support (Boudett & Steele, 2007). Research in China suggests that a long tradition of working collaboratively to substantively shift teaching practices requires strong leadership and external support (Wong, 2010).

Over the past few years, South Africa has been involved in various approaches to teacher development, and particularly the development of science teachers (Jita & Ndlalane, 2009). As discussed earlier, there were professional development programmes which were implemented

to support environmental learning in South Africa. According to Du Toit and Squazzin (2000), these programmes were structured around a spiral model within a cluster-based approach to professional development. The NEEP-GET programme is one programme which worked with groups of educators through a cluster-based approach, where they met on a regular basis to share ideas and experiences related to curriculum development and professional development processes. This led to the establishment of different clusters in South Africa (NEEP-GET, 2004). Teacher clusters represent a recent experiment in the field of teacher professional development in South Africa and are seen as being more suited to helping teachers' knowledge and practices (Jita & Mokhele, 2014). Teacher networks enable teachers to work collaboratively on challenges they encounter in their teaching practice, and thus promote their own continual professional development as individuals and as groups (Villegas-Reimers, 2003). Turkey (2004) concurs that clusters are a tool that could be used by schools to promote collaboration, reflection, sharing and continuous learning among teachers. Researchers have argued that clustering of teachers can and should be considered as a possible intervention strategy to improve schools in South Africa (Jita & Mokhele, 2014).

Jita & Ndlalane (2009) noted that, although there is a fairly rich history of clustering in the 1980s and 1990s among a number of non-governmental organisations (NGOs) and teacher organisations, there is less research on clusters in South Africa. While there is reason to be confident about opportunities offered by several forms of clustering, little is known about how these work and about the possible challenges that exist for teachers who are participating in them. Jita and Ndlalane (2014) say very little research has been done to hear from teachers themselves about opportunities and challenges that exist within these structures. Hence this study is important to shed light on what a PSF offers, what challenges teachers face, and how these can be addressed to support teachers to gain capacity to teach environmental education in NS. But recently there has been a number of emerging studies on PLCs in South Africa (Feldman & Fataar, 2016; Cereseto, 2016; Botha, 2016; Smith, 2016; Molefe, 2016; Chauraya, 2016; Tshiningayamwe, 2016)

Jita and Ndlalane (2009) did a study on teacher clusters in South Africa, to examine the efficacy of clustering as an approach to teacher development for Science and Mathematics. They looked into how structure and function in the cluster interacted to provide the teachers with a rich set of opportunities to learn. They argued that "it is not merely the existence of the structure, namely, the cluster, that provides the opportunity for effective professional development, but that it is interactions among teachers, together with relationships of trust and identity, that make

the cluster an attractive vehicle for challenging and (possibly) changing teachers' professional knowledge and practice" (p. 58).

Feldman and Fataar (2016) also did another study on pedagogical learning among teachers in a professional learning community. Their research highlighted the difficulties encountered in the PLC conversations. They pointed out that their engagement with the teachers in the PLC revealed an absence of both a didactic language and a pedagogic reflexivity. However, by inserting a pedagogical tool into the PLC's deliberations, the teachers developed the capacity to shift and adapt their pedagogical language and teaching practices. This tool was comprised of three elements: the first one was a set of pedagogic transfer modalities using the concepts of pacing and scaffolding; the second one was learner engagement through active participation; and the last one was teacher experimentation with teaching styles. The authors argued that "it is the ongoing dialogical PLC environment that includes a form of 'habitus engagement' and critical pedagogical reflexivity that can adapt and change teachers' pedagogical habitus and teaching repertoires towards a transformative socially just platform that will engage all the learners in the learning process" (p. 36). What this means is that when PLCs offer teachers opportunities to engage in ongoing dialogues about practices that influence their pedagogical approaches, teachers are able to shift and adapt into new pedagogical discourses. Teachers become enabled to consider new teaching practices that actively involve learners in the learning process.

Another example is of a study done by Cereseto (2016). The focus of her study was on choosing a knowledge focus in Geography and English professional learning communities. The findings of the study indicated that learning in PLCs is a slow process and is more likely to be productive if the learning agenda is not imposed upon teachers and they participate voluntarily and choose topics of learning according to their needs.

Another recent research was done by Tshiningayamwe (2016a) on exploring functionings and conversion factors in biodiversity teacher professional learning communities. Her study revealed that if professional development programmes take account of underlying mechanisms and respond to teachers' capabilities in Life Sciences, the professional development programmes can act as conversion factors that expand teachers' capabilities in ways that have the potential to reshape teachers' classroom practices. This study will also expand on exploring how PLCs can contribute to developing teachers' capabilities and valued functionings in Natural Sciences.

2.7. Theoretical framework

For this study the capability approach (Sen, 1987 and Robeyns, 2005) was used. This theory was chosen because of the way it frames the concept of functionings and capabilities. Functioning being the various things a person may value doing or being; and capability refers to the opportunity or freedom that a person has to achieve his or her valued functionings (Sen, 1999). This theory will help me gain insight into what teachers' functionings and capabilities are in teaching environmental content in Natural Sciences, and in being part of a Professional Support Forum, and how these could be used for their professional development.

2.7.1 Capability approach

The capability approach, developed by Amartya Sen, emerged as an intellectual response to various approaches traditionally used for the evaluation and measurement of well-being, as it critiqued the 'information basis' on which they were predicated (Sen, 1999). The capability approach is a broad normative framework for the evaluation and assessment of individual well-being and social arrangements, the design of policies, and proposals about societal change (Robeyns, 2006).

Sen has not directly explored his capability approach theory in education but there is some emerging literature on the implications of this concept for education research (Walker, 2005; Chikunda, 2013; Tao 2015; Tshiningayamwe 2016). Walker (2005) looked at the role of education in promoting functionings in childhood and expanding their capabilities. Chikunda (2013) worked with the theory to explore and expand capabilities, sustainability and gender justice in science teacher education in Zimbabwe and South Africa. Tao (2015) worked with the capability approach to investigate teachers' well-being and the efficacy of teacher in-service training in Tanzania. Tshiningayamwe (2016) explored teachers' capabilities for teaching biodiversity content in Life Sciences curriculum, and the enabling and constraining factors associated with those.

The key concepts in the capability approach are: capability, functioning, agency, human diversity and participation in generating valued capabilities (Walker, 2005). But for this study the concepts I am working with are capability and functioning. According to Sen (1987: 36):

A functioning is an achievement, whereas a capability is the ability to achieve. Functionings are, in a sense, more directly related to living conditions, since they are

different aspects of living conditions. Capabilities, in contrast, are notions of freedom, in the positive sense: what real opportunities you have regarding the life you may lead.

Sen (1999) further explains that a functioning is the various things a person may value doing or being. For this study, functionings are the things that teachers value doing or being in teaching environmental content in Natural Sciences, and in belonging to a Professional Support Forum.

Walker (2005) says the capability approach is about freedom and the development of an environment suitable for human flourishing. She further says capability refers to what people are actually able to be and do, rather than what resources they have access to. Robeyns (2005) further gave clarity that the difference between a functioning and a capability is similar to the difference between an achievement and the freedom to achieve something, or between an outcome and an opportunity. She emphasizes that the core characteristic of the capability approach is its focus on what people are effectively able to do and to be. The capability approach focuses on developing people's capability to choose a life that they have reason to value. For this study, capabilities are what Natural Sciences teachers are able to do (in class or PLCs), what they value from belonging in the PLC, as well as the kind of teachers they can be if the PLCs provide a suitable environment for their professional development. Understanding teachers' functionings and capabilities is important so that professional development programmes can take them into account and respond in a relevant manner. This resonates with what Robeyns (2005) argued when she said "evaluations and policies should focus on what people are able to do and be, on the quality of their life, and on removing obstacles in their lives so that they have more freedom to live the kind of life that, upon reflection, they have reason to value" (p. 94). The capability approach is appropriate for this study because of the way it conceptualizes capabilities, functionings and conversion factors.

Conversion factors are important within the capability approach. They are factors that can enable teachers in PLCs to convert resources into new functionings (Robeyns, 2005). Functionings and capabilities can be both expanded or constrained by conversion factors (*ibid*), which can be grouped into:

1. Personal conversion factors (such as intelligence, physical condition, and skill sets). In this study, personal conversion factors may be the teachers' qualifications, experience in teaching Natural Sciences, their level of confidence, and personal time.

2. Environmental conversion factors (such as geographical location, infrastructure and logistics). The schools surrounding and the classrooms would fall under this category because they could have an influence on how teachers approach environmental content lessons.
3. Social conversion factors (such as public policies, social norms, gender relations, roles and identities). In the case of the study, social conversion factors may be school practices, power relations, teaching resources, the national education policies and school codes and systems. The Professional Support Forum itself, its activities and how they are conducted, and the role of each participant are also examples of social conversion factors (Robeyns, 2005).

According to Robeyns (2005), the personal, environmental and social conversion factors are interconnected. In this study I explore how PLCs can develop teachers' capabilities and valued functionings, and this includes taking into consideration how their capabilities are dependent on these conversion factors.

However, there have been criticisms and debates on which capabilities are significant, or how, when and who is to determine which are the relevant capabilities (Robeyns, 2005). Sen's response to these criticisms is that the problem is not with listing important capabilities, but endorsing one predetermined list of capabilities (Sen, 2004). Sen (*ibid*) further argues that a list of capabilities cannot be made because the lists are used for different purposes, and each purpose might need its own list. The selection of capabilities is also influenced by different social, cultural, and geographical settings. Relating this to the study, the Natural Sciences teachers may have similar functionings related to teaching environmental content and belonging to a PLC but may have different capabilities to achieve those functionings. Robeyns (2005) highlighted the fact that Sen's capability approach is deliberately incomplete and vague; he does not specify which capabilities should count nor how different capabilities should be a collective indicator of human well-being. Sen (1999) noted that he did not produce a list of capabilities because freedom is fundamentally important in making us free to choose something we may or may not actually choose.

In this case, one could argue that the Natural Sciences curriculum policy does have, to some extent, predetermined capabilities which are imbedded in the specific aims of the subject, and the way in which the content of the subject is arranged. For example, it is stipulated in the Natural Sciences CAPS that teachers can be flexible in terms of the time allocated for topics,

depending on their classroom circumstances. This can be considered an implied capability as the policy assumes that teachers are able to assess their learners' progress, and make necessary adjustments. Other implied capabilities are that teachers are able to: make connections between topics that are developed progressively across the grades; promote local knowledge in environmental topics; as well as to equip learners with critical skills and cognitive levels which are required by the subject's specific aims. This goes beyond the content topics, but to the valued knowledge and skills included in the curriculum. The NS CAPS document could also be seen as an enabling conversion factor as it gives teachers the freedom to expand concepts and organize learning capabilities according to their own local circumstances.

Sen (1999) argued that all the members of the PLC should be able to make decisions regarding what to preserve and what to let go; and that those who are affected by any policy and practice should be the ones deciding on what counts as valuable capabilities (Robeyns, 2005). This implies that teachers should be in a position to make decisions about what they value in the teaching of environmental content, and also in how the PLCs are run. However, though the guidelines for PLCs stipulate that policy makers, school leaders and teachers need to work together and have a shared vision on professional development (as discussed in section 2.6.4), teachers' freedom to expand their capabilities is still limited. How the policy talks about teacher development in the PLCs is still descriptive. Officials view PLCs as something to be done *for* the teachers rather than *by* or *with* teachers. One could argue that teachers' concerns over this is an indication that they are concerned about their freedom of decision making and opportunities to achieve their capabilities and valued functionings (Brodie & Borko, 2016). The use of the capability approach in this study was aimed at exploring how PLCs can develop Natural Sciences teachers' valued functionings and capabilities.

2.8. Conclusion

This chapter started with an overview of how international agendas on environmental education influenced South African policies on environmental education. It also discussed how environmental education was integrated into the school curriculum through the National Curriculum Statements, and CAPS. There was also a review of programmes which were established to incorporate principles of Education for Sustainable Development into the school curriculum (Learning for Sustainability Project, NEEP-GET, Eco-schools Programme, and Fundisa for Change). Because of the changes in the curriculum content, the chapter then examined teachers' pedagogic approaches to teaching environmental content. There was a

discussion of teachers' professional development and professional learning communities. The characteristics, challenges and benefits of PLCs were reviewed.

Finally, the chapter introduced the capability approach, which is the conceptual and theoretical framework of this study. The theory looked at teachers' capabilities and valued functionings, and conversion factors associated with them. The capability approach, as well as other insights gained from the literature, enabled me to make sense of the data I generated in this study. The next chapter is the discussion of the research methodology.

CHAPTER 3: RESEARCH METHODOLOGY

Introduction

This chapter discusses the research methods used to generate data for exploring how professional learning communities can contribute to the development of teachers' valued functionings and capabilities in teaching environmental content in Grade 8 Natural Sciences. The chapter gives an explanation of the suitability and limitations of the data generation techniques used in this study. Moreover, this chapter elaborates on how the data was organised and analysed; and finally discusses the issues of validity and ethics that were considered throughout the study.

3.1. Research methodology

3.1.1. Qualitative interpretive research orientation

In exploring how professional learning communities can contribute to the development of Natural Sciences teachers' capabilities and valued functionings in teaching environmental content, I chose to work from a qualitative interpretive perspective. Such a perspective gives an opportunity to understand the situation of the phenomena being studied through the process of interaction. The interpretive approach understands reality to be constructed by the individual, and because reality is constructed, people can have different understandings of reality (Bassegy, 1999).

Qualitative research allows for obtaining a holistic picture of what goes on in a particular situation, in this case in the Natural Sciences classroom and teachers' professional support forum (Terre Blanche, Painter & Durrheim, 2006). According to Denzin and Lincoln (2000) qualitative research is a type of scientific study that seeks answers to a question using a systemically predefined set of procedures in order to be able to answer that question. In a qualitative study, the researcher must get close enough to the participants and the context to personally understand in depth the details of what is happening and capture what actually takes place and what participants say (Lofland, 1971 cited in Patton, 2002). This approach was appropriate for this study because there was active engagement with participants; observing how teachers teach environmental content, and also observation of the activities in the professional support forum (PSF).

3.1.2. Case study approach

The study was in the form of a case study. According to Cohen, Manion and Morrison (2011) a case study provides a unique example of real people in real situations, allowing readers to understand ideas more clearly. A case study can establish cause and effect; it observes the effects in real contexts, recognizing that context is a powerful determinant of both causes and effects, and that in-depth understanding is required to do justice to the case (Cohen et al., 2011).

A case study is not a method, according to Bassey (1999). He explains a case study as a study of particularity and complexity of a case, to understand its activity within important circumstances. However, Yin (1993) argues that the case study is a research method because it covers the methods for empirical research, namely, design, collecting data, analyzing the data and reporting findings. Case study research focuses on one thing – the case, which, according to Yin (1993), is the unit of analysis. Stake (1995), explains that a case study enables the collection of information that is specific to the particular case and that the idea of a case study is to understand a particular case under study. This study is based on a single case of a Professional Support Forum (PSF) of Natural Sciences teachers in the Mahikeng sub-district in the North West province.

As a case study researcher my role has been to observe, and then describe what happens in the case, to look for causal relationships and to report what I have seen – in the classroom and in the professional support forum (Yin, 1993). Additionally, my role was to ask in-depth questions about teachers' valued functionings and related conversion factors in teaching environmental content and in belonging to the professional support forum (PSF) as well as to analyse these rigorously and systematically (Bassey, 1999).

3.2. Research context and activities

3.2.1. Research site and participants

The two guiding principles in selecting settings and participants in qualitative research are “first to identify the groups, settings or individuals that best exhibit the characteristics or phenomena of interest and second to select those that are more accessible and conducive to gaining the understanding you seek” (Maxwell 2012, p. 94). The study was conducted in Mahikeng, in the North West Province within the Mahikeng sub-district for convenience. This is the sub-district where I am based as a teacher, and having access to schools was a lot easier because I have interactions with some of the teachers from the local schools. The research participants were 13 Natural Sciences teachers who filled out the questionnaires; two of whom were observed in

the classroom and interviewed post the observations; and four of whom were interviewed post the PSF observation. All the teachers were from different schools, and part of the professional support forum under study. The teachers who attended the PSF session on the day of observation were about 35, but only 13 of them returned the questionnaires. The other research participant was the Natural Sciences subject advisor who was also interviewed.

3.3. Data generation methods

The following qualitative data generation methods were used: document analysis, observations, semi-structured interviews and questionnaires. The selection of the tools used to generate data was determined by the aims of the study. Patton (2002) argues that these methods capture and provide insight into what happened and report participants' experiences. The methods are outlined in detail in the following sections.

3.3.1. Observations

According to Cohen et al. (2011) observation is looking and noting systematically people, events, behaviours, settings, artefacts and routines. They further indicate that through observation, the researcher gets an opportunity to gather live data from a naturally occurring social situation; directly looking at what is taking place *in situ* rather than relying on second-hand data. But a criticism of this method is that it can be subjective, meaning that different researchers can observe the same phenomena but see different things (Flick, 2014). To prevent this, the observer must have a clearly defined observation tool which will be a guide to collect data (Gobo, 2011).

3.3.1.1. Classroom observations

Observation of teachers in the classroom teaching Natural Sciences lessons on environmental topics was a valuable method because I did not have to depend only on what teachers have reported in the questionnaire, but could capture their capabilities and realize their valued functionings.

Observations were done with two teachers. Initially I had arranged with six teachers for classroom observations during the first term of 2018, but due to protests in town I could not attend to other schools. I ended up doing observations with only two teachers – two lessons of 30 -35 minutes, per teacher. But this was not an issue because the purpose of classroom observation was to get some insights into how teachers teach environmental content in Natural

Sciences. The focus of the study and the unit of analysis was on the professional support forum. The observation data was generated to answer research sub-question one (see section 1.4).

I made arrangements with the teachers to observe two lessons under the topic of “Interactions and interdependence within the environment”. Both teachers gave their consent by signing a consent form (see Appendix A). The first teacher (coded as T1) was teaching on the topic of “Adaptations” in the first lesson observation and “Conservation of the ecosystem” in the second one. The second teacher (coded as T2) was teaching “Balance in an ecosystem” in the first lesson observed and “Conservation of the ecosystem” in the second one. All lessons were conducted during the Natural Sciences periods as allocated on the teachers’ timetable to avoid disruption of the schools’ programmes. This was done during the third week of February. I had an observation schedule (see Appendices B1 & B2) which guided me to look for relevant aspects that would be evidence of teachers’ valued beings and doings, and the conversion factors related to these functionings. I observed the setting of the classroom, the teaching methods and approaches the teachers used, and the classroom interactions. Observing the classroom settings such as the size of classrooms, number of learners, sitting arrangements, and wall displays was important in terms of linking what teachers would say about the environmental conversion factors in their schools, and what was actually observed.

I assumed a position of a non-participant observer, and was introduced as such to the learners before the lessons commenced. I took pictures of materials used during the lessons and copies of learners work (see Appendices C1 and C2)

To ensure the validity and quality of my lesson observations, I audio-recorded and transcribed the lessons for review (see Appendices D1- D4). These were followed by interviews with the teachers (see section 3.4.2.1).

3.3.1.2. Professional Support Forum observation

To answer sub-question two of my study: what are teachers’ valued functionings in the Professional Support Forum and what conversion factors in the Professional Support Forum are associated with these functionings? I had to seek permission from the subject advisor, as well as the teachers, to observe the PSF activities. The primary focus of the observation was to develop a deeper understanding of teachers’ valued beings and doings in the PSF and how they relate to their functionings in teaching environmental content in the classroom. It was also to get insight into conversion factors related to those valued beings and doings.

The PSF session was held on the 28th of February 2018, and 35 teachers attended. There was an agenda (see Appendix E) for the session, led by the subject advisor. My position as a researcher was made known to the teachers; and I was also a participant observer as I was part of the PSF. Observing the PSF was useful because it provided insights into issues related to teachers' valued beings and doings in the PSF and conversion factors that might enable or constrain them. The duration of the observation was about two and half hours – which was the duration of the PSF session.

I had an observation schedule (See Appendix F) which I did not use during the observation, but instead wrote observation notes (see Appendix G). I used the schedule when I was organizing my data. For validity, I did follow-up interviews with teachers and the subject advisor.

3.3.2. Semi-structured interviews

Interviews enable participants to discuss their interpretation of the world in which they live, and to express how they regard situations from their own points of view (Cohen et al., 2011). McMillan and Schumacher (2006) regard an interview as a purposeful interaction, usually between two people focusing on one person trying to get information from another person. In qualitative research there are three common types of interviews: structured, semi-structured and unstructured interviews (Cohen et al., 2011). Koul (1984) defined structured interviews as those interviews in which there is a standardized procedure to be followed which is determined in advance. Semi-structured interviews provide greater flexibility, although a series of questions and procedures to be followed are determined beforehand. In the third type of interviews, unstructured (open-ended), there are few pre-determined questions and there is greater flexibility and freedom for both the interviewer and the interviewee (Cohen et al., 2011). For this study I used semi-structured interviews because they enable me to probe interviewee's thoughts, values, prejudice, perceptions, views, feelings and perspectives (Leedy & Ormrod, 2005).

3.3.2.1. Post-classroom observations interviews with teachers

Following the classroom observations, I conducted semi-structured interviews with each one of the two teachers. I was only able to conduct the interviews six weeks after the classroom observations. I used semi-structured interviews because they are highly flexible (Easton, 2010). The interviews enabled me to explore teachers' approaches in teaching environmental content in Natural Sciences and the challenges they might have with the topic. It also enabled me to understand the teachers' valued beings and doings in teaching the environmental content, and the conversion factors that may expand or constrain their valued doings and beings. The interviews also helped me to gain clarity on what I observed during the lessons, and also enabled the teachers to give explanations for their own behaviour, practices and actions to me as an interviewer (Walker, 1995). I had to use the audio recording and the observation notes to enable teachers to recall what transpired during their lessons.

The interviews were guided by an interview schedule (See Appendix H) which had open-ended questions based on the research question and related concepts. All the interview sessions, which were between 15– 25 minutes long, were audio-recorded and transcribed before being analysed. Both interviews were conducted at school during break times. The audio recordings and the transcripts were clearly labeled and safely stored in multiple back up storages. The transcripts were scanned and stored in both soft and hard copy. The transcripts are attached as Appendices I and J.

3.3.2.2. Post PSF observation interviews with teachers

The aim of the interviews was to get more insight into things that came out of the two questionnaires. I interviewed four teachers individually – those who had attended the PSF sessions and completed the questionnaires. The interviews were conducted two months after the PSF meeting. I used open-ended and semi-structured interview questions, and all interviews were audio-recorded. Each interview was about 20 minutes long, and they were all transcribed for analysis (See Appendix K).

3.3.2.3. Interview with the subject advisor

The subject advisor was interviewed because she might have insights into how the PSF is structured as well as teachers' functionings and conversion factors that enable or constraint teachers from achieving their valued functionings in the PSF. The interview was done five months after the PSF observation. It was a semi-structured interview and was about 10 minutes long (See appendix L).

3.3.3. Document analysis

Documents are original objects that are related directly to the events being investigated (Cohen et al., 2011), and they are primary sources that are useful in qualitative research because of the nature of the data they contain (Yin, 2011). The Grade 7 – 9 Natural Sciences Curriculum and Assessment Policy Statement was of relevance to this study because it is a formal policy document which guides teachers' curriculum planning. The curriculum document was analysed to gain insight into the environmental content which Grade 8 teachers are expected to teach in Natural Sciences.

The work schedules (also referred to as the annual teaching plan) of both teachers were analysed – but it was the same document because they are both in the same sub-district. The work schedule provided a prescribed environmental content to be taught and for how long it was to be taught and lesson plans (See Appendices M and N) enabled me to see how teachers plan for teaching environmental topics, what resources they use, how and when. One of the teachers provided me with her lesson preparation book, which illustrated how she planned her lessons. I could not get a copy of the teacher's book because the teacher misplaced. However, later she provided copies of lesson plans, which contained the same information as was in the preparation book.

3.3.4. Questionnaires

The questionnaire is a widely used and useful instrument for collecting survey information, providing structured data, being able to be administered in the absence of the researcher and often being comparatively straightforward to analyse (Cohen et al., 2011). I used questionnaires with open-ended questions to enable teachers to write a free account in their own terms, to explain and quantify their responses and avoid the limitations of pre-set categories of responses (Cohen et al, 2011). The first questionnaire (See Appendix O) was designed to give information on teachers' qualifications, teaching experience, their perceptions and teaching practices related to environmental education, and their professional development. The second questionnaire (Appendix P) was focused on the PSF and teachers' reflections on the session. The initial plan was to hand out the first questionnaire at the beginning of the PSF session for teachers to complete, and the second one at the end of the session for reflections. But this did not happen due to time constraints.

The first set of questionnaires was given to the two teachers that I had to observe in the classroom. I did so because the topic that I was going to observe was due to be taught earlier

than the date for the PSF session. I gave them the first questionnaire to complete before the classroom observations because I wanted to establish their profiles and also get a sense of what they value in teaching environmental content before I could observe them in the classroom. The second questionnaire was given after the attendance of the PSF session.

The other teachers who participated in PSF session were given both questionnaires after the session. Some teachers had already left by then, so the questionnaires were sent to them via email, and some were delivered to schools. Retrieving the completed questionnaires was a difficult task; and out of 20 questionnaires handed out a total of 13 were received. A spreadsheet in which all the questionnaires were transcribed was created. All the copies were scanned for back up.

3.4. Data generation and management

The data were generated through methods already mentioned in the previous sections – observations, document analysis, questionnaires and interviews. All the hardcopies – interview transcripts, field notes, observation schedules and other documents - were stored in a flip file which was labelled accordingly. I also scanned all the hardcopies and stored them digitally on my personal computer. I made a backup of all the data by saving them on a hard drive; uploading all to Dropbox and One Drive; and sending to an email address specifically created for my study.

3.4.1. Index coding

All the data sources used in this study were coded for easy access and reference. All participants were given index codes to ensure that their real names do not appear in the thesis as promised to them. An inventory of the data indexing is presented in Table 3.1 below:

Table 3.1: An inventory of data indexing

Data type	Source	Index coding and explanation	Appendix
Curriculum and Assessment Policy Statement Grade 7 – 9 Natural Sciences		D1: Document 1	
Lesson observation	Teacher 1 and 2	LO1T1: lesson observation 1 for teacher 1 LO2T1 LO2T2 LO2T2	D
Professional Support Forum observation	Teachers and subject advisor	PSFO: PSF observation	G
Post lesson observation Interview	Teacher 1 and 2	PLOIT1: Post lesson observation interview for teacher 1 PLOIT2	I J
PSF follow-up interviews with teachers	Teachers 1 - 10	FIT1: follow-up interview with teacher 1	K
Interview with subject advisor	Subject Advisor for Natural Sciences	ISA: interview with subject advisor	L
Lesson Plans	Teacher 1(T1) and 2 (T2)	LP1T1: lesson plan 1 teacher 1 LP1T2:	M and N
Profiling Questionnaires	Teacher 1 - 10	PQT1 – PQT10: profiling questionnaire for teacher 1	O
Reflection questionnaires	Teacher 1 - 10	RQT1 - RQT10: reflection questionnaire for teacher 2	P

3.5. Data analysis

According to Cohen et al. (2011), data analysis involves organizing, accounting for and explaining data. This means that one has to make sense of the data by noting patterns, themes, categories and regularities in terms of the participants' explanation of the situation. Gay, Mills and Airsian (2006) add that data analysis is the process of making sense and finding meaning in the data, interpreting what has been seen and what has been said.

The analysis was done in three phases which are discussed in detail in the following sections.

3.5.1. Phase one analysis

The purpose of the first phase of analysis was to answer the first sub-question: how do Natural Sciences teachers teach environmental content in the classroom? Phase one was primarily inductive with data from questionnaires, classroom observations, and document analysis (work schedules and lesson plans).

In analyzing the documents, I firstly looked at the Natural Sciences CAPS document to see what is outlined in the topics I observed, what teachers are expected to teach, as well as the suggested and recommended activities. Then the lesson plans and the preparation books were viewed to see how teachers planned for their lessons and see whether the plans were in line with what has been stipulated in the CAPS document, to what extent they plan for environmental topics and the resources they plan to use. From the classroom observation notes and schedules, I looked further into how the lesson plan plays out in practice. The focus was on things such as teachers' teaching methods, learners' engagement and classroom setting.

Document analysis concentrates on the relationship between the documents and how they are used by the teacher (Prior, 2011). Data generated through the reviewing of documents and classroom observations was analysed by writing summaries and inductively coding it.

Data generated from the questionnaires and the interviews were analysed by developing themes and categories. Some of the categories were related to the classroom observation schedule. The themes and categories were not imposed but rather it was made certain that they emerged from the data (Patton, 1990).

3.5.2. Phase two analysis

This phase of analysis was focused on sub-questions two, three and four (see section 1.4). The analysis of data in this phase was deductive, and guided by literature on characteristics of professional learning communities. In deductive analysis the researcher begins with theories, assumptions or hypotheses and uses the data to confirm or negate the ideas (O'Leary, 2004). Data generated from questionnaires, classroom and PSF observations was analysed under broad themes. These were then organized into categories using a constant comparison, by carefully reading across all the transcripts. Firstly, I identified what teachers noted as their valued doings and beings related to the teaching of environmental content, from classroom observations, interviews and questionnaires. Similar valued doings and beings from interviews and questionnaires were colour coded to make it easier for me to generate analytical statements. Analytical statements are, according Bassey (1999), based on raw data but speak directly to the

research questions. The analytical statements helped to answer the four sub-questions of the study.

To answer sub-questions three and four of the study, data from the questionnaires, PSF observations, and interviews with teachers and the subject advisor were used. Again here, the teachers' valued doings and beings related to belonging to the PSF were clustered using the characteristics of PLCs from literature. I analysed the data according to the categories listed in Table 3.2 below.

Table 3.2: Example of categories of data for the PSF (adapted from Stoll et al. (2006), p. 226-227).

Number	Categories	Evidence of / sub-categories
1	Shared values and vision	Collective decision making. A vision focused on student learning and shared values guide discussions and decisions about teaching and learning. Agenda of the day
2	Collective responsibility	Participation (to what extent)
3	Supportive conditions	Time for collaboration Resources Sharing teaching strategies Trying new strategies Getting feedback (from subject advisor & from other members of the group) Taking part in redesigning curriculum & methods of instruction
4	Shared leadership	Taking leadership roles (e.g. facilitation, setting the agenda, defining outcomes)
5	Reflective professional inquiry	Conversations about educational issues or problems involving the application of new knowledge; joint planning. The kind of questions teachers ask.
6	Group, as well as individuals' learning promoted	Creating knowledge collectively; subject knowledge (environmental content). Studying further.
7	Other valued beings and doings	

3.5.3. Phase three analysis

An abductive mode of inference was used to get a deeper understanding of the factors that either enabled or constrained teachers valued doings or beings related to teaching environmental content, and belonging to the PSF. According to Danermark et al. (2002) the fundamental of abduction is to interpret and recontextualise individual phenomena within the conceptual framework or a set of ideas. In this study I used an analytical conceptual framework from the capability approach by Sen (1989) to look at the data in a new way. I used the theoretical lenses to establish what conversion factors are related to teachers' valued beings and doings. With thick descriptions I clustered the conversion factors under the three types of conversion factors; social, environmental, and personal, as grouped by Robeyns (2005). These are shown in Table 3.3. Using the reduced data from phase two analysis - what the teachers said during interviews, what was read from the questionnaires, and what was observed in the classrooms and the PSF - I analysed how these conversion factors enabled or constrained teachers' capabilities. The analysis provided answers to sub-questions two and three, which in turn answered sub-question four.

Table 3.3: Example of sub-categories from the capability approach theory.

Conversion factors	Sub-categories
Personal	Teachers' qualifications; Experience in teaching Natural Sciences; Level of confidence Personal time
Environmental	Learning space, time and duration of PSF; and frequency Logistics; where the PSF is happening
Social	Teaching and learning materials (access to); activities in the PSF; Policies (CAPS); (policy guiding the PSF) Roles in the school and the PSF

Analytical memos were developed to capture teachers' valued functionings related to teaching environmental content and in belonging to the PSF; as well as conversion factors related to these functionings. Examples of the analytical memos are in Appendices W1 and W2.

3.6. Validity and trustworthiness

According to Bassey (1999), validity is the extent to which a research finding is what it is claimed to be. Validity requires identifying threats to the rigorous and trustworthy representation of the data, such as researcher bias and reactivity. Cohen et al. (2011) argue that in qualitative data validity might be addressed through honesty, depth, richness, and scope of

data achieved, the participants' approach, the extent of triangulation and the objectivity of the researcher.

For validity and trustworthiness in my study, I used three types of validity: descriptive validity, interpretive validity and theoretical validity (Maxwell, 2012).

Descriptive validity refers to the factual accuracy of the account as documented by the researcher. Glaser and Strauss (1967) explain that descriptive validity forms the base on which all the other forms of validity are built upon, and without an accurate account of the formative data all else is irrelevant. The data must accurately reflect what the participant has said or done. The way in which the data is reported must also reflect the same accuracy (Glaser & Strauss, 1967). In this study I made sure that the transcription of the interviews was an accurate account of what was said, and that the description of my observations portrayed the unfolding of events in an accurate manner.

Within the qualitative paradigm, interpretation is typically viewed as an unavoidable element of data collection. Interpretive validity, according to Maxwell (1992), seeks to comprehend phenomena not on the basis of the researcher's perspective and categories, but from those of the participants in the situations studied. I had to ensure that my interpretation of what I observed in the classrooms and the PSF, what I heard from the interviews, and what I read from the questionnaires represented the perspectives of the teachers. After classroom observations, follow-up interviews with the teachers were carried out to enhance the validity of the data. The observation schedule and the audio-recording of the lessons were used to verify the data and deepen the insights from the observation process. I also requested the teachers to read the transcripts of the interviews to minimize researcher misinterpretations (Maxwell, 2005). The same was done with the PSF observation; four teachers and the subject advisor were interviewed. From the transcriptions substantive descriptions were done to make sure that there was no misinterpretation of the phenomena.

Theoretical validity is the degree to which a theoretical explanation developed from the research findings is consistent with the data (Maxwell, 1992). Theoretical validity goes beyond the concrete and descriptive and concerns itself with the constructions that the researcher applies to, or develops, during the research (Maxwell, 1992). Theoretical validity seeks to evaluate the validity of the researcher's concepts and the theorized relationships among the concepts in context with the phenomena. A theory includes the concepts or categories that the theory employs and the relationship thought to exist between the concepts (Maxwell, 2012).

The concepts used in this study were PLCs, professional development, capabilities, functionings, conversion factors and environmental education. These were all related to the research questions and were engaged during the study.

To increase the validity of my data I used multiple sources of data - lesson and PSF observations, questionnaires, individual interviews as well as documents to triangulate my findings. It helped me to look for consistency, patterns and discontinuities in the data. According to Yin (1993), using multiple data collection methods rather than one method only on the same unit of analysis would make the researcher more confident of the findings. The respondents should be asked the same questions, and the same theoretical categories should be applied to the different sources of data. Should the researcher get the same or similar results, one can be confident that the data has been successfully triangulated (Yin, 1993). However, it is not always possible to ask the same questions to the respondents when using semi-structured interviews. As the interviewer I asked some questions based on the responses from the interviewee as I probed further.

3.7. Ethics

In qualitative studies, ethical dilemmas are likely to emerge with regard to the collection of data and dissemination of findings (Merriam, 2001). According to McMillan and Schumacher (2006), ethical issues include policies regarding informed consent, safety, deception, confidentiality, anonymity, privacy and caring. Upon receiving an ethical clearance certificate from the University (Appendix Q), permission from to carry out this study was sought from the North West Department of Basic Education in writing (see Appendix R). Access to schools and teacher's classrooms (Appendix S) was granted. I wrote letters to the principals and the Natural Sciences teachers of the schools concerned in order to obtain authorization (see Appendices T & U). I also obtained permission from my principal to proceed with the research so that I can conduct classroom observations in other schools during school times. Although teachers were informed about my research by their principals, I wanted to ask for their permission too so that they do not feel obligated to participate in the study. I then issued consent forms (see Appendix A) to teachers who agreed to participate in the study. The form contained the following information; a brief description of the nature of the study, voluntary participation, guarantee that all responses would remain confidential and anonymous, a place to sign and date the letter indicating agreement to participate, researcher's name, and contact details (Leedy & Omrod, 2005). I informed the participants of their rights to withdraw from the study any time

should the need arise; and that I would respect their right to refuse to participate or withdraw (Cohen et al., 2011). They were informed that their information would remain confidential and not be shared with anyone except my supervisor. The only teachers who signed the consent forms were those that were going to be observed in classrooms and interviewed; and the subject advisor as well.

Before I started with classroom observations I asked permission from the teachers to audio-record the lessons and the interviews. I showed the teachers the transcripts of the recorded data so that they could check if I had interpreted their data correctly.

For the PSF, observation permission was sought from the subject advisor. At the beginning of the meeting I was given a chance to introduce my research to the teachers and explain what it is all about, and ask permission to record the process. Although I wished to take photos during the meeting, most teachers indicated that they were not comfortable with that, so I decided not to take any to respect their wishes.

Confidentiality and privacy were discussed with the participants (Cohen et al., 2011). All interviews, questionnaires and other data sources were treated with confidentiality, anonymity and non-traceability for participants who want these (*ibid*). But for the subject advisor anonymity was not guaranteed because she would be recognized by her position. I made sure that I give her the transcript of our interview, so that she could check to see if I can use everything she said, or make some changes. All the data sources were kept safely and shared only with my supervisor. Participants were guaranteed of their full rights to get a detailed copy of the finding of the study upon its completion.

My position as a Natural Sciences teacher and a participant in the PSF played an important role in this study. My position as a researcher was made clear to all participants. Being a Natural Sciences teacher myself I had to ensure that my preconceptions about the environmental topics I observed being taught in classrooms, and about the PSF did not compromise the research. During the generation and analysis of the data, I did member checking to ensure that I accurately represented what participants said and did to minimise bringing my own perceptions or assumptions. I had to be conscious of how my subjectivity might influence the interpretations being made. Recognizing my position as a researcher allowed me to be transparent throughout the process, and to be open and honest with the participants.

3.8. Limitations

Initially I had planned to use focus groups as another method of data generation, but due to protests that took place in Mafikeng during my data collection period, it fell off. Schools had to do recovery programmes, and teachers had to remain with learners until late in the evenings, so there was no time to meet. But the other methods I used generated sufficient data.

When I approached the subject advisor about my research, she agreed to include the environmental topics as focus for content discussions in the first PSF meeting. But due to the restructuring of the districts and clusters by the Department of Basic Education, things changed. The first PSF meeting in the first term was more of an orientation session; there was no focus on specific subject content. I had initially wanted to observe how the teachers engaged with environmental content in the PSF setting, and how after the PSF would their classroom practise be influenced. However, I discussed it with my supervisor, and we agreed that I can still use the observation of the activities that happened in that meeting; I could identify gaps and opportunities that emerged from there and discuss them.

3.9. Conclusions

In this chapter the interpretive qualitative research orientation of the study was discussed, including the appropriate nature of case study approaches, which allow for phenomena to be studied in real world setting. The methodology and the tools used in the generation of data to answer the research questions related to functionings, conversion factors, and teacher development through PSFs in relation to teaching environmental content in Natural Sciences were discussed. Documents were selected for analysis, observations, interviews, and questionnaires were used to generate data for this study. The data were stored in multiple ways, electronically as well as in hardcopies. The analysis of data was done in phases, inductively, deductively and abductively, and through the use of the theoretical framework constructed making use of the capability approach. The chapter ends with a brief discussion on how issues of validity, trustworthiness and ethics have been dealt with, as well as discussion on the researcher position in the study.

CHAPTER 4: TEACHERS' VALUED BEINGS AND DOINGS

4.1. Introduction

This chapter describes the data that emerged from the analysis of the curriculum documents (CAPS document and lesson plans), questionnaires, interviews, lesson observations, and PSF observations. The chapter starts by discussing the analysis of the Natural Sciences CAPS document; the organisation of the Natural Sciences Curriculum; and the organisation of environmental topics and the progression thereof in different phases and grades (see section 4.2). This is followed by how teachers teach the environmental topics in their classrooms (see section 4.3). This section describes the teaching methods and resources teachers use in their lessons; and also draws from questionnaires, interviews, and classroom observations. The chapter also describes teachers' valued beings and doings in teaching environmental content (see section 4.4). The chapter concludes with teachers' valued beings and doings related to belonging to the PSF (see section 4.5).

4.2. Natural Sciences CAPS document

The Natural Sciences CAPS curriculum is the official document stipulated by the Department of Basic Education, and is used by all teachers in teaching the subject. One of the many principles upon which the curriculum is based is "human rights, inclusivity, environmental and social justice: infusing the principles and practises of social and environmental justice and human rights ..." (see section 2.4). The CAPS document specifies what teachers should teach and the timeframe of teaching it. Natural Sciences is organised into four knowledge strands, which are used as a tool for organising its content (South Africa. DBE, 2011a, p. 9). The aims, principles of and environmental themes in the Natural Sciences (NS) CAPS document have been discussed in Chapter 2 (section 2.4). In this section I present the analysis of the CAPS document.

4.2.1. Time allocation

In the senior phase (Grades 7 to 9), the instructional time allocated for NS in the CAPS document is ten weeks per term, with three hours per week. NS has been designed to be completed within 34 weeks in Grade 7, 8, and 9. Assessment in term one and three is allocated 6 hours, while term two and four work covers eight weeks each, plus two weeks for revision and examinations (D1, p. 9). The curriculum allows teachers to be flexible in terms of the time allocated per topic; according to their classroom circumstances and to accommodate the interests of the learners. The lesson plans of the teachers observed in classrooms showed that

both teachers were following the time allocation for each topic as indicated in the NS CAPS document (See Appendices M & N).

The time allocations given to the different topics provide an indication of the weighting of each topic. According to the curriculum, a significant amount of time should be spent on doing practical tasks and investigations which are regarded as an integral part of the teaching and learning process. The NS CAPS document does not specify how much time should be spent on practical task.

4.2.2. Organisation of the Natural Sciences curriculum

As explained in section 2.4, the Natural Sciences curriculum is organised into four knowledge strands. Each strand is developed progressively across the three years of the Senior Phase. It has been emphasised that it is important to make learners aware of the links they need to make with related topics in order for them to achieve an understanding of the nature of and the connectedness in the Natural Sciences. At Senior Phase, Natural Sciences lays the basis of further studies in more specific Science disciplines such as Life Sciences, Physical Sciences and Agricultural Sciences (D1, p. 8). Appendix V shows progression of environmental studies from the Intermediate Phase to Further Education and Training (FET). Learners in the Senior Phase should have prior knowledge of environmental topics from the lower grades, and they should carry the knowledge forward to FET. In the intermediate Phase the subject related to Natural Sciences is Natural Sciences and Technology; and in FET it is Life Sciences, in relation to the Life and Living strand. In Grade 9 there are no links to the environmental topics, it continues in Grade 10. In FET, there are indications on the CAPS curriculum of where the links are with other grades. For example, in Grade 10 it is indicated that the topic of Biosphere is linked to prior knowledge from Grade 8. I wrote in bold and underlined where links are specifically stated in the CAPS document (see Appendix V). During lesson observation, LO1T1, it was evident that the teacher, when teaching on adaptations in ecosystems, made links of some of the topics to other subjects and grades as noted in the following extracts:

“Do you know Africa, the top part of Africa? You must be doing this in SS [Social Sciences]”

“...broader leaves help the plants retain more water. A plant will roll its leaves at the edges, so that it retains water. What do we call that process? You have to know it from Grade 5, 6, and 7”.

Also in LO2T1 the teacher indicated that the learners will learn some of the concepts about biodiversity in Grade 12.

4.2.3. Activities and resources

The CAPS curriculum has a guideline of activities that teachers can use for each topic, and the resources that they can use. The activities include investigation, practical work, and demonstrations. The extract below, Table 4.1., is an example of how these have been structured in the NS CAPS document.

Table 4.1: Example of activities suggested for each topic in the NS CAPS document.

Topic	Content & concepts	Suggested activities: investigations, practical work, and demonstrations
Interactions and interdependence within the environment	Introduction to ecology Ecosystems Energy flow Balance in the ecosystem Adaptations Conservation of ecosystem	<ul style="list-style-type: none"> • drawing and labelling diagrams of any selected plants, and describe in the labels how they are adapted to their environment • reading and writing about how animals are adapted to live in extreme environments (camel and polar bear); how animals are adapted to being good predators (shark and cheetah); and about other animal adaptations such as camouflage and mimicry • writing about the importance of maintaining biodiversity and sustainable use of natural resources • writing about irresponsible human practices (such as inappropriate waste disposal) and their impact on ecosystems. Suggest possible solutions • evaluating the impact of various factors (such as loss of habitat, loss of species, change of weather or climate) on ecosystems • evaluating the impact on a food web when one of the organisms is removed

These activities are aimed at developing a range of process skills in the teaching and learning of Natural Sciences (discussed in detail in section 2.3). Some of the activities are practical investigations, for example, under the topic of ecosystems one of the activities is “identifying a food chain or food web in an ecosystem in or near the school ground. Record the observations”. Practical work speaks to Specific Aim 1 of NS which says “learners should be able to complete investigations, analyse problems and use practical processes and skills evaluating solutions (D1, p. 38). Most teachers who filled out questionnaires indicated that they do not do practical activities during their lessons because of a lack of resources.

The resources that teachers need for teaching each topic are listed next to the topic to help them in their planning and preparation (D1, p. 35-38). The list is only a guide and teachers may use other resources other than those listed in the document. The CAPS document indicates that every learner should have access to sufficient workspace and equipment to carry out investigations. It also recommends that for safety purposes no more than three learners share space and equipment (D1, p12). In a questionnaire, PQT3 indicated that the number of learners in her classes are too big for learners to do experiments themselves, thus she only does demonstrations for them. Teachers are aware of the requirements of CAPS for practical work, but the context does not always allow them to do all of them. The CAPS document explicitly states that schools must make efforts to provide for essential equipment. But it notes that where equipment is limited, teachers should improvise, than not do investigations or practical work due to lack of equipment. The same knowledge and skills can be developed using improvised equipment (D1, p. 12).

Textbooks are also resources which are listed on the guideline of materials that teachers can use for each topic. The CAPS document notes that all learners must have textbooks, and the teachers should ensure that there is a retrieval system for recovering the textbooks at the end of the year (D1, p. 12).

4.3. Teaching methods

In the questionnaire teachers were asked to identify the methods they use in teaching environmental content in NS. Most teachers identified direct teaching, discussions, and questions and answers, as the main teaching methods they use in teaching environmental content. T2 further wrote that group discussions give her a chance to see what learners understand, and she probes their understanding by the question-answer method, and this enables learners to learn from each other. T11 added that he uses questions to test learners’

prior knowledge. Of the 13 teachers, only one (T5) indicated that she does outdoor lessons. All teachers indicated that the main resource they use in their teaching is textbooks. Six of the teachers (T4, T5, T7, T9, T10 and T11) indicated that they used ICT (projectors and laptops) in their lessons (see table in Appendix W1).

I asked the teachers that I observed in class the following question: “*How do you decide on the teaching methods you are going to use for each lesson, and the material you will need?*” One teacher responded as follows:

Since I am still new in teaching, I rely on the CAPS work schedule. It kinda guides one on how to teach each topic. There are suggested activities and practicals or demonstrations. So I go through it when I do lesson preps. At times we don't have all the resources at school but I improvise. But personally, I prefer teaching and asking questions every now and then to see if they understand. (PLOIT2)

The other teacher said:

I mean this is not something you think too much about. It comes with experience. When I do my lesson preparations, I can see whether I am going to need to perform an experiment or not. If so, I prepare all the apparatus I will use in class, do the experiment alone first to see if it works, then perform it with learners in class. So you plan as you go. (PLOIT1)

4.3.1. Summary of classroom observations

4.3.1.1. First teacher's lessons

The observation schedule of T1 lesson observation is Appendix D1. Two lessons were observed from the topic of interactions and interdependence within the environment. This is a topic taught in Grade 8 in the first term.

T1's first lesson was on the sub-topic of adaptations in the ecosystem. The teacher started the lesson by recalling what she taught learners in the previous lesson, which was on balance in the ecosystem. She asked learners questions on natural and human factors that disrupt the balance of the ecosystem. Learners were actively involved in identifying factors such as illegal hunting, pollution, and illegal removal of animals and plants from their habitats. They also discussed natural factors such as fires, droughts, and floods.

Then the teacher started by linking that to the lesson of the day which was on adaptations. She explained what adaptation is, and used different examples of animals that can adapt to different environments. Learners were given printed notes to work on during the lesson. The teacher concluded the lesson by asking learners to go and prepare for a test on the two topics she did with them.

The second lesson started off by doing remedial work of the home work given in the previous lesson. Then the teacher introduced the topic of the day which was conservation of the ecosystem. She explained different concepts and terms, gave notes on the chalkboard, and gave learners some class work to do.

4.3.1.2. Second teacher's lesson observation

The first lesson of T2 was on the topic of balance in the ecosystem. The teacher continued from the previous lesson on ecosystems. She asked learners to give examples of living and non-living things. Then she explained concepts such as carrying capacity using examples that learners could relate to. The discussion went on to factors that disrupt the ecosystem. At the end the lesson the teacher gave learners what she called a speed test. Questions were asked orally as learners wrote answers in their books (see Appendix C1).

The second lesson was on conservation of ecosystems. T2 started by writing important definitions on the chalkboard, and told learners to keep referring to the list during the lesson. Discussions were on how people can save the environment and on sustainable use of natural resources. Learners were then given an assignment to write on the importance of maintaining biodiversity.

4.3.2. Teachers' lesson plans

T1 told me that she usually updates her lesson plans after the lessons. The teacher had what she called a lesson preparation book and explained that it is a book in which she prepares her lessons before going to the classroom. After her lessons she then uses a lesson plan template to translate what she has written in her book. The lesson preparation book included the date of the lesson, topic of the day, summarised notes of the topic, and activities to be given to learners. Teacher 1's lesson plans included the topic, grade, teaching strategies, lesson objectives, resources used, the teacher's and learners' activities, and assessment (LP1T1 and LP2T1). The teacher provided lesson preparations for both of her lessons (see Appendices M1 & M2).

The other teacher (T2) provided one lesson plan only (see Appendix N), for the first lesson. The lesson plan included the subject, grade, date, duration, topic, sub-topic, content, lesson objective, teaching methodologies, teacher activities, learner activities, inclusivity, expanded opportunities, assessment, resources, and reflections. (LP1T2)

4.3.3. Observed teaching strategies and resources used during the lessons

4.3.3.1. Asking questions

Both teachers were using this method in all their lessons. They would start by presentation of the lessons, and in between the presentations they used questions to probe learners' understanding. Below are extracts of lesson observations of how teachers used this method during their lessons:

Example of Teacher 1's lesson (LO1T1)

The teacher asked the following questions to recap on the previous lesson.

T1: *Give me the natural factors that can disturb the ecosystem.*

Learner: *Fire*

T1: *What other examples do you know?*

Learner: *Floods*

T1: *what are the human factors you know?*

Learner: *illegal hunting.*

Learner: *Pollution*

T1: *Yes. Pollution. Toxic gases will be in the atmosphere causing damage to everything. The last one?*

Learner: *illegal removing of animals from their habitat*

T1: *yes. Illegal removal of animals and plants from one place to another.*

The teacher then introduced the topic of the day, which was on 'adaptation'. She explained to the learners the different types of adaptation. During the lesson she asked learners a question about the skin colour of people who stay in the northern part of Africa. Learners were able to answer the question, and the teacher explained that their skin is dark because it has to adapt to the high temperatures.

Example of Teacher 2's lesson (LO1T2)

T2: *Today we are on the topic of balance in the ecosystem. We previously defined what an ecosystem is, right? And we know that the ecosystem consists of living and non-living things. Give me examples of living things.*

Learners: *Organisms, people*

Learners: *animals and plants*

T2: *and examples of non-living things?*

Learners: *resources*

Learner: *food*

Learner: *light*

Learner: *habitat and temperature*

The teacher explained balance in the ecosystem using example of rabbits and grass. She drew on the chalkboard and asked learners what will happen to the population of rabbits as the grass decreases. Learners were able to respond to the questions.

Both teachers used this strategy throughout their lesson presentations, but there was little evidence of further probing. Most of the questions the teacher asked required one word answers only or short explanations.

4.3.3.2. Explaining and giving notes

In LO1T1 and LO2T1 the teacher gave learners notes on the chalkboard to write during the lesson. She allowed learners to copy the notes into their books before explaining them. In the first lesson, she handed out copies of pages from a textbook and asked learners to keep referring to it. The teacher asked learners to highlight some of the words. For example, the teacher said “*I am going to give you notes to look at how other animals are adapted to their environment. At the top [of the sheet] I want you to highlight important points, there is a definition for adaptation; highlight it.*” LO1T1. The second teacher also wrote summary notes on the chalkboard; mostly definitions.

4.3.3.3. Using pictures

This strategy was only observed in LO1T1. The teacher gave learners copies from a textbook different from the ones they were using in the classroom. There were copies of different animals and how they are structurally adapted to their environments. The teacher kept referring learners to the figures of animals as she explained. For example, she said “*Now let’s look at the second animal, the bear, on the next page. Look at the figure. Polar bears are well adapted to cold arctic conditions...they have a very big fur...it has a very large body ...It has small ears and a little tail...*” (LO1T1)

4.3.3.4. Incorporation of everyday local issues

During LO1T2, the teacher was talking about factors that can contribute to the imbalance in the ecosystem. She gave an example of the recent drought issue in Cape Town. Learners could relate to that because it has been on the news and they knew about it.

4.3.3.5. Different forms of assessments

In LO2T1, the teacher started by doing remedial work on a previous task which was on explaining the meaning of some of the terms she was going to teach about on that day. The following were the terms she gave to learners: biodiversity, monoculture, alien species, conservation, and sustainable use. The teacher used these terms as a starting point of the topic of conservation of ecosystems. In LO2T2 learners wrote some classwork at the end of the lesson.

From LO1T2 and LO2T2 two forms of assessment were observed. In the first lesson the teacher gave learners what she called a speed test, after teaching. Here are the questions the teacher asked:

- *What do we mean by carrying capacity?*
- *Describe how an ecosystem can be destroyed or disrupted*
- *List three natural factors that can destroy the ecosystem*
- *Use one of the factors mentioned above to explain how the balance of the ecosystem is disrupted.*

The teacher asked these questions orally while learners were writing in their books. The questions were based on what she was teaching. Then in her second lesson (LO2T2) she gave learners an assignment to write on the importance of maintaining biodiversity.

Although the focus of this study was not on the assessment of the environmental content, I felt it was important to highlight the assessment practices observed during lesson observations. It was also important to highlight it because it shows what teachers do and value in the teaching of environmental content; they recognise that learners need to be assessed on this work. The NS CAPS document defines assessment as “*a continuous and planned process of identifying, gathering, interpreting and diagnosing, information about the performance of learners. All forms of assessment involve generating and collecting evidence of achievement; evaluating this evidence and using this information to understand and thereby assist the learner’s development and the teaching process*”. (D1, p. 85). The document further highlights that assessment should be both formal and informal. The forms of assessment the teachers used during lesson observations were all informal ones. According to the CAPS document, informal assessment consist of regular checking of learners’ class work (including practical tasks), asking questions orally – which was done by both teachers – and giving constructive feedback. The following is an extract from the CAPS document about informal assessment:

The purpose of informal assessment is to continuously collect information on a learner’s achievement that can be used to improve their learning. Informal assessment is a daily monitoring of learners’ progress. It should not be seen as separate from the learning activities taking place in the classroom. Informal assessment can be done through observation, discussion, practical demonstrations, informal classroom interactions, classwork, and investigations and so on. Informal assessment may be as simple as stopping during the lesson to observe learners or to discuss with learners how learning is progressing. Informal assessment should also be used to provide feedback to the learners and to inform planning for teaching (D1, p85-86).

In both teachers’ lessons, I took note of the assessments given to learners. Some of the questions included defining terms such as adaptation, variations, biodiversity, alien species, conservation, and sustainable. There were also questions that required learners to list or state certain things related to the topics that were taught (see Appendix C1).

Having given descriptions of how the different methods and strategies teachers used in teaching environmental content, in the next section I present their valued beings and doings (valued functionings) related to that.

4.4. Teachers' valued beings and doings in teaching environmental content in Natural Sciences

This section answers research sub-question two on what teachers' valued beings and doings in teaching environmental content are. As explained in section 2.8.1, valued beings and doings, which are also referred to as valued functionings, are things that teachers may value doing or being in teaching environmental content in Natural Sciences.

To explore the teachers' valued functionings in teaching environmental content, they were interviewed and also asked in questionnaires. It is important to remember that although the teachers are all teaching NS, each individual teacher may have different valued functionings.

From the follow-up interviews done with the two teachers who were observed in the classroom, this is what emerged. One teacher said she would like to get help with the topics of Adaptations and Conservation of Ecosystem. *"...I was not as confident as when I was teaching the first one ... I would love to get help with teaching materials that are interactive like videos, for learners to see how different animals adapt to the environment"*. (PLOIT1)

Regarding the topic of Conservation of the Ecosystem she further said *"I enjoy teaching it but I want to get learners to be able to relate to it. I wish I could get help and take them to Mafikeng Game reserve so that they can see what conservation means and learn more"*. (PLOIT1). When asked about what she wished the Department of Basic Education could do to help in teaching NS, she responded by saying *"The subject advisor should come to our school to see our situations, and provide us with everything that we need, like resources for teaching. The department should also take us to different workshops to learn how to teach different topics in NS"*. (PLOIT1)

The second teacher indicated that she would like to get help in the topic of Adaptation and the concept of extinction. She also mentioned helping learners with basics in Grade 7 Biodiversity topic (PLOIT2). The teacher wanted the Department of Basic Education to support them in studying further. This is what she said:

"Maybe if they made it possible for us to register for short courses like Nature Conservation, so that we increase our knowledge in those topics. Or they could also help us affiliate with certain programmes that can help us develop us in our teaching and get more knowledge". (PLOIT2). In follow-up interviews with four of the teachers who are part of the PSF, they

expressed their valued beings and doings in teaching environmental content in NS. Table 4.2 gives a summary of that.

Table 4.2: Teachers’ valued beings and doings in teaching environmental content.

Valued beings and doings related to teaching environmental content
Getting help with topics of Adaptation, conservation of ecosystems, extinction, biodiversity in Grade 7
Getting interactive teaching materials
Taking learners on excursions in Mafikeng Game Reserve
Attending different workshops
Studying further for short courses like Nature Conservation
Having small numbers of learners in my class
Doing outdoor lessons
Support from the subject advisor
Affiliating with certain programmes to develop in teaching and to get more knowledge
Finding an easy way of making the learners relate the topic to the real environmental issues that are local.
Bringing back learners’ interest in NS
Being helped with better teaching strategies of teaching those topics
Relating the topic to the real environmental issues that are local
Learning more about the topics, improve skills in teaching it and having the confidence of teaching it.

4.5. Teachers’ valued beings and doings related to belonging to the PSF

This section answers the first part of research sub-question three, and draws from data generated through questionnaires, interviews and PSF observation. The questionnaire was asking generally about Natural Sciences PSFs meetings that teachers usually attend, and specifically about the one that I observed. In the questionnaire I asked teachers to indicate the number of years they have been in the PSF, which were captured in Table 4.3 below.

Table 4.3: Indication of teachers' number of years in the PSF.

Teacher	Number of years in the PSF
T1	3 years
T2	Few months
T3	Not indicated but said for a very long time
T4	3 months
T5	3 years
T6	1 year
T7	4 years
T8	9 years
T9	3 years
T10	8 years
T11	2 years
T12	10 years
T13	1 year

Of the 13 teachers, eight of them (T1, T3, T5, T7, T8, T9, T10 and T12) have been part of the PSF for more than three years. One question in the questionnaire required respondents to elaborate on the professional development support they receive or activities they participate in for professional development. Most teachers (PQT3, PQT2, PQT1, PQT5, identified the PSF as a professional development they participate in. But it seems like some teachers are attending the PSF only because it is compulsory as suggested by the following extracts: “*compulsory to attend PSF and/ or workshops*” (PQT3); “*I participate in PSF which is compulsory*” (PQT7). Some indicated IQMS, SACE CPTD Science Expos, TED videos on educational issues, unions as professional development activities they engage in (PQT7, PQT11, and PQT12) (see Appendix W2).

4.5.1. Roles in the PSF

Teachers were asked about the roles they play in the PSF. Most of the teachers who indicated that they have a role in the PSF referred to participation in group discussions and sharing information (PQT2, PQT5, PQT12, and PQT13). For example one teacher (FIT6) said “*We take roles in working together as groups, and presenting our work in front of other colleagues*”.

However, there were other teachers; five of them; who indicated that they do not play any role in the PSF. Examples of how teachers responded are given in the extracts below:

In the PSF there are no activities that offer one a chance to play an active role. But in my school I am very active, I lead a science club. The teacher further elaborated in a follow-up interview saying “In the sessions I have attended we have most of the times been recipients. But we do engage in discussions at times. In some sessions we do practicals together that we are supposed to do with learners. But I wish it happened often because I learn the most when we do these kind of activities”. (PQT11, FIT11)

The other teacher who was also interviewed said the following:

We teachers don't do anything big. We only need to show up with whatever the subject advisor needs from us like files and learner books. There are times we would have discussions, but it does not happen often. But last year we had a workshop in term three, at least that was different because teachers were actively involved in practical activities. We were trained by people from Space Agency something. We had different roles. Group leaders, presenting group works and other things.

But in the PSF we attended last month, we did some useful things. Maybe it's because it was the first time I attended the NS at the beginning of the year. We did some group activities of setting practical activities for Grade 8 and 9. (FIT13)

The above extracts regarding teachers' roles in the PSF demonstrate that there is limited teacher role in PSFs. This is also supported by what I observed in the PSF meeting which was held at the beginning of the year. For much of the time the subject advisor was the one leading the PSF. Teachers only got actively involved when they set in groups to set up practical activities for learners. But the teachers' responses show that they have different views of what they consider as a role (see Appendix W2).

Having heard how teachers described their roles in the PSF, I asked the teachers about the role of the subject advisor. Teachers noted that the subject advisor does almost everything in the PSF, from setting up the agenda to giving presentations, leading discussions, providing materials, and giving direction. The extracts below present what teachers said:

FIT13: *She does everything. She would normally start the meeting with some motivation. Then she goes into policies and administration things. Hey, she takes a lot of time in that. Then she*

will talk about school performances for previous exams. Basically, she does almost everything in the PSF.

FIT11: *she is the one who gives us the agenda for the day. Starts with presentations and lead discussions. If there are any materials to hand out she will give them to us. When we have sessions where we do practicals, she gives us all the necessary apparatus. I'd say she is responsible for the whole planning of the PSF.*

In an interview with the Subject Advisor, she explained what her roles and responsibilities are. These included: monitoring and support, conducting PSFs, analysis of results, accountability for performance, assisting teachers in lesson plan preparations, inducting newly appointed educators, and school visits. In school visits she monitors the implementation of the curriculum, checks the timetable, checks analysis of results, Annual Teaching Plan coverage of teachers, teachers' and learners' performance, and communicates with principals, HODs and the teachers. (ISA)

In responding to the question of roles in the PSF, the Subject Advisor identified herself as the facilitator, and noted she works together with the teachers. This is what she said: *“We are there to communicate about the subject generally. In term one we look at the policy imperatives, from there we go to the content and concepts to be taught in the subject. Depending on what type of PSF it is. If it is induction, I will induct them on policy imperatives. When it is subject content training, we are going to discuss the content. When it is time for practical, we perform practicals”.* (ISA)

From the teachers' comments one could say the subject advisor is the one who does almost everything in the PSF. Probing further I asked the teachers if there are any other facilitators besides the subject advisor; one teacher explained that most of the times it is the subject advisor. She pointed out that they had external facilitators only once, who came to facilitate a training on a specific strand (FIT13). All the other teachers (FIT3, FIT6 and FIT11) also reiterated the same thing that most of the times the subject advisor was the only facilitator they had.

4.5.2. Activities in the PSF

In this section I report on the activities that took place in the PSF. The data presented here is from teachers' responses from questionnaires, interviews and also the PSF observation. Teachers were also asked to indicate whether these activities benefit them and explain how, if they do. The following are the activities that emerged from the data:

4.5.2.1. Presentations

All the teachers, except one, who stated presentations as one of the activities in the PSF said they did not benefit from them. Two of the teachers said the following: “*sometimes class presentations are prepared. I don’t think they benefit me*” (PQT3); “*A lot of talking by the subject advisor. I cannot say it benefits me*” (PQT12). That one teacher (PQT5) who said presentations benefited her referred to presentations by teachers, not the subject advisor.

4.5.2.2. (Group) discussions

Teachers indicated that they do engage in group discussions. They further indicated that group discussions give them an opportunity to learn from each other; to discuss topics that are challenging to them; to share new teaching strategies; and to gain knowledge about the subject (PQT1, PQT4, PQT9, and FIT6). This was also evident on the day I went for PSF observation. Teachers grouped themselves according to the grades they teach. They were then given a task of setting up practical tasks for formal assessments. In all the groups teachers engaged in discussions about the topics they want to assess, how they should structure the task and other things related to the task. During the discussions, one of the groups had to ask for the NS CAPS document to verify which skills should be assessed through practical tasks.

4.5.2.3. Administration

From the interviews, teachers also pointed out doing administration related activities in the PSF. Teachers responded differently regarding this activity; some said it benefited them when they started teaching NS, but it no longer does (PQT7, PQT8, PQT10, PQT11, FIT1, FIT13). For example T7 responded as follows: “*Orientations are no longer that important because I am now used to how things work.* (PQT7)

The following comments were noted from interviews with two teachers:

“*Sometimes we take our files there and learners’ books. We exchange them with other teachers, and we check the curriculum coverage, whether the teacher is in line with the ATP [Annual Teaching Plan]. Then we count number of activities. We have to report back to the subject advisor. I don’t find the task useful for us. The subject advisor should do that when she visits our schools*”. (FIT13).

“*About 80% of the time is spent on admin issues. I don’t benefit from that unless there are new requirements. The rest we have group discussions and practical tasks*”. (FIT3)

Others find the administration activity helpful and beneficial. One teacher wrote “*NS PSF is different from the ones I have been attending for my other subjects. But I find them beneficial because they help me understand NS better*” (PQT13).

During the PSF observation I noted that this is an activity which took up much of the time. Due to the fact that it was the first PSF of the year, too much time was spent on orientation about the subject. The subject advisor went through the CAPS document and presented the requirements for the subject. Then she shifted to talking about schools’ performances in the previous year’s final examination (referred to as NWPA – North West Provincial Assessment). Teachers were then given copies of programme of assessment (PoA), annual teaching plan (ATP), and other documents that should go into teachers’ and learners’ files.

4.5.2.4. Practical activities

Three teachers (PQT1, FIT1, FIT13, and FIT11) indicated that in the PSF they do practical activities. They pointed it out when they explained their roles in the PSF. “*In some sessions we do practicals together that we are supposed to do with learners. But I wish it happened often because I learn the most when we do these kind of activities*” (FIT11). The teacher further said “*When we have sessions where we do practicals, she (the subject advisor) gives us all the necessary apparatus*”.

4.5.3. Restructuring of the PSF

In trying to understand teachers valued beings and doings in the PSF, I asked in the questionnaire how they think the PSF could be structured in such a way that it benefits them more. In responding to that, teachers expressed what they would like to see happening, and what should change in the PSF. Their responses are presented in Analytical Memo 2 (see Appendix W2). Five (PQT1, PQT6, PQT9, and PQT12) of the teachers talked about the need to have more time and sessions of the PSF. PSFs are normally held once per school term, and the duration of the sessions is about two hours.

It was also evident that teachers valued discussions on subject content. One teacher noted the following:

“We need more workshops that deal with administration and then ones that deal with content, that supply past question papers that have been written and then us as teachers we break it down and come up with ways to improve the subjects”. (PQT2)

Other teachers also shared the same sentiments. The following extracts are evidence of what the teachers said: *“I will like us to discuss content...”* (PQT6); *“I am interested in discussing content”* (PQT8); *“Spend more time discussing subject content, that’s what matters at the end of the day”* (FIT11); *“Focus on how to teach biodiversity in Grade 7. Hear from other teachers, or even have the subject specialist teach the topic, or other teachers”* (RQT7).

The need to have separate sessions for different groups of teachers, and having different facilitators were identified as valued beings and doings. One teacher indicated that they would like to be grouped according to their subject majors and get assistance where they are lacking (PQT5). Another said they would like to have separate sessions for new and advanced teachers (PQT13). Others indicated that the subject advisor should give teachers space to teach each other and share teaching techniques (PQT6 and PQT11), and also invite other specialists to the PSF (PQT9).

It was also evident that another valued functioning was the freedom to make decisions about points of discussion in the PSF meetings. The teachers said *“I wish the subject advisor could allow us teachers to come with our own points of discussion. Especially for content discussions”* (PQT10); *“If we could be given an opportunity to say what we as teachers want to discuss”*. (PQT8)

I asked the subject advisor if she consults teachers to hear what it is that they would like to discuss in the PSF, and she said *“Yes. In most cases we get which topics give them problems. I am also informed by the analysis to see which topic is a problem at which school”*. (ISA)

For others it was more about getting teaching and learning resources (PQT1, PQT2 and PQT4).

From the follow-up interviews that were conducted teachers elaborated further on their valued beings and doings regarding the PSF. These are captured in Analytical Memo 2 (see Appendix W2).

4.5.4. Teachers’ reflections on their expectations of the PSF

Questionnaires were handed out to teachers for them to write down what their expectations were for the PSF session they had just attended; the one that I observed. Three of the teachers noted that they did not have any expectations. They said: *“Every time we go there we engage in same activities. So I don’t have high expectations”* (RQT12); *“I did not have any expectations because the meetings are always the same”* (RQT10); *“I did not have much expectations because we always do the same things. Listen to the subject advisor the whole*

session” (RQT8). From the interviews one teacher commented on the question of expectations by saying: *“I no longer have any expectations because we have the same routine every session”*. (FIT1)

It is evident that teachers, though they are all teaching NS, have different valued beings and doings of the PSF. One teacher said in a follow-up interview *“NS is not my major. So the first time I went there I was expecting discussions on different topics; teachers talking about their different experiences and challenges in teaching those topics. But none of it is happening. I also expect to be provided with teaching material, past question papers and anything that can help me in teaching NS. So my expectations are not always met”*. (FIT13)

Most teachers valued discussing subject content, especially topics they find difficult (FIT13, FIT6, FIT11, RQT7, RQT6); being provided with teaching and learning materials, (FIT13, RQT11); having the freedom to talk about classroom challenges (FIT6); sharing teaching strategies (FIT11); being hands-on (RT11) The question of teachers’ expectations gave an opportunity to draw more on what teachers’ value most in belonging to the PSF.

Other teachers said their expectations were met. For example one teacher wrote *“to discuss difficulties encountered, yes they were met”* (RQT2); while another one wrote *“yes, we managed to set practical papers”*. (RQT5)

4.5.5. Teachers’ reflections on what they benefited from the PSF

Teachers were asked to reflect on the PSF which was held at the beginning of the year, by writing down what they benefited from that session. See Analytical Memo 2 (Appendix W2). Of the 13 teachers who filled out the questionnaire, only three of them stated that they did not benefit (RQT1, RQT8, and RQT12). For example one teacher wrote *“Nothing much. I know how to do admin stuff. I know about all the requirements for NS. The session was more focussed on basic things for new teachers”* (RQT8). All the other teachers mentioned how they benefited from that session. Six of the teachers mentioned that they benefited in terms of meeting with other teachers, having discussions and networking (RQT4, RQT6, RQT7, RQT9, RQT10, and RQT13).

What also came up as a benefit was setting practical activities (RQT10 and RQT5); learning the subject requirements (RQT2 and RQT13); skills and knowledge (RQT9 and RQT4). It is evident from the given extracts that teachers benefited differently from the same PSF session.

Responding to the question of whether the PSF is able to meet teachers' professional development needs, the subject advisor responded by saying "100% ... *During PSFs we discuss policy imperatives, we discuss practical activities that are to be assessed during that period. We are going to assess the content and concepts to be taught during that period. Therefore I think it's 100%. (ISA)*

4.5.6. Further professional support that teachers would like to receive

Another question which sought to understand teachers valued beings and doings further, was asking teachers what more professional development support they still needed. This is how teachers responded to the question:

RQT13: *I need more teaching resources. But ultimately I want to be moved from teaching NS because it is not my major and I do not entirely enjoy teaching it.*

RQT12: *I am thinking of studying so that I can at least get a promotional post.*

RQT10: *Subject advisor visits to our school. That would be helpful because she will be able to see what we need in terms of teaching and learning materials at school.*

RQT7: *focus on how to teach biodiversity in Grade 7. Hear from other teachers, or even have the subject specialist teach the topic, or other teachers.*

Other teachers pointed out that what they need is to be provided with teaching resources (RQT2, RQT4, RQT6, RQT8 and RQT11), and they also want more discussions on subject content and of informal and formal assessments (RQT8, RQT1, RQT3 and RQT1). One teacher mentioned the use of ICT (Information and Communication Technology) (RQT8), and another two mentioned having different facilitators, either other teachers in the PSF (RQT7) or people from other organisations (RQT6).

The last question on the reflection questionnaire was asking teachers to give comments or suggestions regarding the PSF or their own professional development. Of the 13 teachers who filled out the questionnaires, only three of them (RQT3, RQT2 and RQT5) did not respond to the question. There were various suggestions provided by other teachers. Some suggested that there should be more PSF sessions held. "*More PSF to be held so that progress can be measured*" (RQT1). "*...increase the number of meetings, maybe twice per term*" (RQT8). Another one wrote "*...once-a-term PSFs are not sufficient*" (RQT11). Two of the teachers (RQT4 and RQT9) perceived the PSF to be a good learning space where they can share and develop knowledge and skills in teaching Natural Sciences. For example RQT4 wrote "*PSF*

are good because they develop teachers' knowledge and skills", while RQT9 wrote *"it's good to have these PSFs to share knowledge and be motivated to teach the subject"*. Other teachers, particularly those who have been part of the PSF for years, felt a need to restructure the PSF. One teacher wrote *"we need different setting of the PSF. Fresh and innovative ideas for teaching NS"* (RQT10). Others suggested that the subject advisor invite different organisations to offer workshops; separate PSFs for different purposes; mini workshops for neighbouring schools; and a variety of activities in the PSF.

The above data illustrates the teachers' suggestions and opinions on how they think the PSF should be. They give more insight into the educators' valued beings and doings.

4.6. Conclusion

In this chapter I presented the data generated from interviews, questionnaires, classroom observations and PSF observations. The data were on teachers' valued beings and doings in teaching environmental content and in belonging to the PSF. The analysis showed that teachers' had similar valued beings and doings in relation to teaching environmental content, as well as in belonging to the PSF. In the next chapter I discuss conversion factors related to these valued beings and doings.

CHAPTER 5: CONVERSION FACTORS RELATED TO TEACHERS' VALUED BEINGS AND DOINGS

5.1. Conversion factors related to teachers' valued beings and doings in teaching environmental content

In trying to understand the conversion factors associated with teachers' valued functionings related to teaching Natural Sciences, teachers were asked in the questionnaires and interviews why they are teaching the subject, the challenges they encounter in teaching NS, and in teaching the environmental content specifically. This also addresses sub-question two of the study. Their responses were clustered under Robeyns' (2005) three conversion factors: the personal, environmental and social. Conversion factors are factors that can enable or constrain teachers to convert resources into new functionings (see section 2.7.1). Although the teachers had identified similar valued beings and doings in teaching environmental content, they needed different support to achieve those. The conversion factors are presented below.

5.1.1. Personal conversion factors

5.1.1.1. Teachers' qualifications and experience

Table 5.1 below shows the qualifications and experience of the 13 teachers who participated in the study. It is evident that the 13 teachers in the study who are teaching Natural Sciences are qualified. The qualifications ranged from Bachelor of Education to Bachelors of Science. Of the 13 teachers who filled the questionnaires, eight of them (T1, T3, T4, T5, T6, T7, T9 and T12) majored in Education while the other five (T2, T8, T10, T11, and T13) had Bachelor of Science degrees (B.Sc.), with one teacher (T8) still studying towards an Honours degree in Education. All the teachers with B.Sc. qualifications had a Postgraduate Certificate in Education (PGCE). It is also evident from the table that teachers majored in different specialisations i.e. Mathematics, Life Sciences (Biology), Biomedical Sciences, Chemistry, Physics, Microbiology, Botany, Electronics, Computer Sciences, and English. Six teachers have majored in Life Sciences or Natural Sciences, which makes them specifically qualified to teach Natural Sciences.

Table 5.1: Teachers' qualifications and experience in teaching.

Teacher	Qualifications	Number of years teaching	Experience in teaching Natural Sciences
T1	UDEIS; Further Diploma in Biology teaching; ACE	23 years	2 years
T2	PGCE (Math-GET and Life Sciences-FET); BHSc (Biomedical Sciences)	1 year	Few months
T3	Diploma of Higher Education	30+ years	18
T4	B.Ed. in Senior Phase and FET	3 months	3 months
T5	B.Ed. (Senior Phase and FET) – Life Sciences and English	3 years	2 years
T6	Bachelor of Education	2 years	1 year
T7	B.Ed. (Maths and Life Sciences); B.Ed. honours	6 years	4 years
T8	B.Sc. Biology and Chemistry; PGCE (Physical Sciences and Natural Sciences); Completing B.Ed. honours	10 years	9 years
T9	B.Ed. (Geography and English)	5 years	5 years
T10	M.Sc. Physics, PGCE	9 years	8 years
T11	B.Sc. (Microbiology and Botany); PGCE (Life Sciences – FET and NS – Senior phase)	2 and ½ years	2 and ½ years
T12	Secondary Teachers Diploma	20 years	15 years
T13	B.Sc. Electronics and Computer Sciences; PGCE (Physics-FET and Technology – Senior Phase)	9 years	1 year

Four teachers did not specify their majors, and three majored in subjects that can enable them to teach some strands of Natural Sciences e.g. those who majored in Physics can teach the Energy and Change strand, and those with Geography can teach the Planet Earth and Beyond strand. Most of the teachers indicated in the questionnaires that they teach other subjects at school which included Life Sciences (PQT1; PQT2; PQT8;PQT11;PQT12), Geography (PQT4; PQT12), Physical Sciences (PQT3; PQT10; PQT13), Technology (PQT2; PQT13), Mathematics (PQT6;PQT7), English (PQT5;PQT9) and Life Orientation (PQT8; PQT9) in different grades. All teachers were teaching Natural Sciences in Grade 8, except for three (T4, T5 and T6); in some instances it was a combination of grades – Grade 8 and Grade 9 (T1, T9 and T10); Grade 7 and 8 (T7, T11 and T12).

When it comes to experience in teaching, most of the teachers were experienced. In the case of this study experienced teachers were considered to be those with three or more years of teaching; both teaching in general and teaching NS specifically. Of the 13 teachers, nine teachers (T1, T3, T5, T7, T8, T9, T10, T12 and T13) had three or more years of teaching, with three of them (T1, T3 and T12) having 20 or more years of experience. The novice teachers'

experience ranged from three months to three years (T2, T4, T6 and T11). For experience in teaching NS, six teachers (T3, T7, T8, T9, T10 and T12) have been teaching for three or more years, while seven of them (T1, T2, T4, T5, T6, T11 and T13) were still new in teaching NS.

In the interviews and questionnaires, some teachers indicated that they are teaching Natural Sciences because they are qualified to teach it; and some said it is because of their passion for the subject. The extracts below are from the questionnaires, and are evidence that teachers considered their qualifications as either an enabling or constraining personal conversion factor in teaching Natural Sciences.

“It forms part of my subject knowledge and education” (PQT3).

“I specialised with Biology – NS included...” (PQT1).

“Because I did Life Sciences at University...” (PQT5).

I majored in Life Sciences, so I can teach NS because they are related” (PQT7).

Some teachers acknowledged that their experience and qualifications were constraining factors to their capabilities to teach Natural Sciences. One teacher talking about experience said:

I only started teaching last year, and I was given Grade 7 NS and Chemistry in Grade 10. I struggled a bit because it was my first teaching job, but I got used to it. Then beginning of this year my allocation was changed. I was moved to Grade 8 NS, Life Sciences Grade 10 and Technology Grade 8. Now I had to struggle again to teach NS in Grade 8...I know the content because I majored in Life Sciences, but teaching it is not easy. I just wish they will not move me from Grade 8 again next year because it would help me to master the content and gain confidence in teaching NS in Grade 8.
(PLOIT2)

This teacher had one year teaching experience and less than a year teaching Natural Sciences. There were other teachers who also indicated a lack of experience was a personal conversion factor that constrained them even though they had relevant qualifications (PQT1, PQT5, PQR7 and PQT11). For others, despite being experienced teachers in other subjects, not having the relevant qualification and content knowledge was a constraining factor, the extract below was taken from an interview with a teacher who has been teaching for nine years, but has been teaching NS for only a year.

Like I told you, my majors are Electronics and Computer Science. I also studied for PGCE in Technology. So last year the teacher who was teaching NS left, and because I have a science degree they gave me NS. Honestly, I don't enjoy it because I have never taught it before. I don't know the content. I have to teach myself before I go to class. I'm not qualified for it but because we don't have enough science teachers I had to take it. (FIT13)

The above extract also demonstrates how school dynamics can contribute to personal conversion factors that constrain teachers valued beings and doings. The teacher (FIT13) had to teach NS because of a shortage of science teachers.

One other thing that became evident from the interviews and questionnaires is the advantage of having novice and very experienced teachers in the same school. They both learn from each other as they work together. One teacher noted:

I teach NS with two other teachers in Grade 8, and I must say it is good to work with young teachers in school because they understand these things of technology. I am a BBT – born before technology, so I never used a computer when I teach. But since they came they are teaching me to make power-point lessons. But most of the time I ask them to connect for me before I start my lessons. I am still learning you know. (PLOIT1)

This teacher has been teaching for 23 years, but she acknowledged that working with beginner teachers is an enabling personal conversion factor since she is learning how to use technology to develop her valued functionings and capabilities in teaching Natural Sciences. Another teacher who had only two and half years teaching experience noted that:

It is not that bad because I have two senior teachers who are helping me. I mean, they have been teaching for a very long time, they know NS even in their sleep. One of them when I came here taught me how to do lesson plans and organise NS files. Every time I need help with some topics that I find difficult I go to her. (FIT11)

The conversion factors that teachers indicated were not necessarily for the environmental topics only; some were for the NS subject in general. But I found them important to highlight. Other teachers indicated that their challenge was in teaching other strands in NS: “*It (NS) is made by four components i.e. Life Sciences – which is my major, and chemistry, physics and geography are challenging; difficult to teach*” (PQT1). “*I did not do physics and chemistry at school, I only did Life Sciences. So I am confident in teaching NS in term 1; Life and Living. But other*

terms I have to learn first” (PQT5). As mentioned in section 2.4, in Senior Phase Natural Sciences is divided into four knowledge strands which are developed progressively across the three years of the Senior Phase (D1, p. 14). The content in the Life and Living strand is mostly Life Sciences; Matter and Materials is chemistry; Energy and Change is Physics; and Planet and Beyond is Geography. Therefore it becomes a challenge because most teachers did not major in all four subjects. This was also confirmed by the subject advisor that other teachers did not major in science, so it becomes a challenge for them to teach some topics. But most of the topics she identified were not environmental topics, except for Biodiversity in Grade 7. (ISA)

The responses of teachers to the question of challenges in teaching the topic of interactions and interdependence within the environment are captured in Table 5.2 below.

Table 5.2: Teachers’ challenges in teaching the topic of interactions and interdependence within the environment.

Data extract	Data source
Classes are too big to do experiments themselves; thus only demonstrations	PQT3
Is how to relate the two processes to learners, it sounds confusing to them	PQT1
Adaptation and extinction	PQT2
Learners fails to understand biotic and abiotic factors on their environment and fail to understand how they relate.	PQT4
Not being able to relate the topic to local environmental	PQT7
I cannot do outdoor lessons because our school does not have things like garden (flowers) trees or anything environmental	PQT8
Not having field trips for learners to experience nature	PQT9
I'm more of a physics person, so that topic was a bit of a challenge to teach. But over the years I got better at teaching it.	PQT10
The topic of extinction	PQT11
When I give learners research projects on topics like sustainable use of natural resources, they don't do it	PQT12
That's one of the topics I don't enjoy teaching because it's life science. I do it just to finish	PQT13

5.1.1.2. Teachers' passion and interest

Of the 13 teachers who filled out the questionnaire, seven (PQT1; PQT2; PQT4; PQT7; PQT8; PQT11 and PQT12) indicated that they love NS and are passionate about it. To give a few examples, here are some quotes from the questionnaires:

"I specialised with Biology and I have interest in the learning area" (PQT1).

"I love Biology and that is what I studied for. I'm good at it" (PQT8).

"I have been teaching NS for many years now, and I am passionate about it" (PQT12).

It is evident that passion and interest are teachers' personal conversion factors that enable them to achieve their valued beings and doings.

One of the two teachers who were observed during lessons also demonstrated passion in the way she delivered her lessons. Her enthusiasm (the tone of her voice, facial expressions, and body language) in presenting the lesson showed passion. The learners were showing interest in the lesson because of how she taught the topic (LOIT1). In her interview she said *"I love teaching the Life and Living topics in term one. It's part of what I teach in Life Sciences ..."* (FIT1)

There were, however, teachers who indicated that they do not have the passion of teaching NS, and the environmental topics. In a follow up interview one teacher said:

...Honestly I don't enjoy it because I have never taught it before... It's not for me. I am just doing it for those children". (FIT13)

In the follow up interviews, I asked the two teachers that I observed in class, which topics they enjoy teaching the most in Grade 8. One teacher said *"I am a Life Sciences major, and have a bit of chemistry from my qualification. I therefore enjoy teaching topics related to that"* (PLOIT2). When I asked what about environmental topics she further said *"In Life Sciences we do have such topics. But they are not my speciality. I specialised in Biomedical Sciences. So I have to read more and learn some of the concepts in those environmental topics. I do the same even in Grade 10. But I honestly cannot say I enjoy them. I love human biology more".* (PLOIT2)

5.1.1.3. Learners interest and participation

Teachers mentioned that another factor that constrains the teaching of environmental topics, and NS in general is lack of interest from learners. When responding to a question of challenges

in teaching NS and environmental topics, teacher PQT3 wrote this “*no interest from learners*”, while teacher PQT4 wrote, “*learners are not related (are not familiar with) to those resources that I use, and they also fail to submit my work on time*”. Teacher PQT6 wrote, “*...Learners are not doing their homework*”, and teacher PQT8 wrote “*learners don’t show interest*”.

According to my classroom observations, learner participation was minimal during some of the lessons. I observed two teachers and two lessons for each. For most of the time the teachers did much of the talking, while learners sat there listening to the teachers. In LO1T1 learners were very engaged and the lesson was interesting. The classroom was well controlled and learners were disciplined. The teacher kept asking questions, and learners were responding – although it was the same learners who were actively asking and answering questions. In the second lesson (LO2T1), conservation of ecosystems, learners were just taking notes and the teacher kept talking with less questioning. The teacher herself acknowledged after the lesson that the class was boring. She said it was because she did not thoroughly prepare for the lesson. In LO1T2, it was evident that the learners were out of control most of the times. The teacher had to stop teaching every now and then to reprimand them. At one point I had to step in because they were not listening to the teacher and being disruptive. Despite the disruptions, there were few learners who were answering questions when the teacher asked. The teacher gave them some classwork, and some were not even writing.

5.2. Environmental conversion factors

5.2.1. Learning space – the classrooms and the schools’ surroundings

In the profiling questionnaires teachers were asked to indicate the number of learners in their classrooms. These are the numbers indicated by the 13 teachers, shown in Table 5.3.

Table 5.3: Average number of learners in teachers' classrooms.

Teacher	Number of learners in classrooms	Teacher	Number of learners in classrooms
T1	58	T8	~40
T2	~ 60 per class	T9	30 per class
T3	45 per class	T10	~40
T4	55 per class	T11	40+ per class
T5	87	T12	>40
T6	46	T13	~ 50
T7	35		

The numbers show that most of the teachers had overcrowded classrooms. Some of the teachers indicated that large classes were a challenge to them. Teacher PQT3, in responding to a question on challenges in teaching the topic of interactions and interdependence, specifically wrote, “*Classes are too big to do experiments, thus only demonstrations*”. PQT2 also wrote, “*Overcrowding*”. PQT8 also identified overcrowded classrooms as a challenge because it is “*Not easy to give attention to all learners*”. It is evident that space is very important, and overcrowded classrooms are an environmental constraint in teaching in general.

The teachers only talked about overcrowded classrooms, but during my classroom observations, I noted a few things about the classroom settings and conditions. In both classrooms there were more than 50 learners. There were not enough desks, and some learners had to sit three or four on a desk; but the desks were properly arranged in rows that allowed space for moving around. There were no displays on the walls; not even timetables (See Appendices B1 & B2).

The teachers also revealed that the schools' surroundings play a role in their teaching of the environmental topics. From the questionnaires PQT8 wrote “*I cannot do outdoor lessons because our school does not have things like garden (flowers) trees or anything environmental*”. The two teachers who were interviewed after classroom observations also commented as follows when asked if they do outdoor lessons: PLOIT1 said “*No. Our school yard doesn't have anything that can be used for NS lessons*”. The second teacher, PLOIT2 said

“I have never done that. I mean there is nothing around the school that I can use for demonstrations or experiments in my lessons”.

In relation to the schools surroundings, teachers were asked in the questionnaires to indicate the state of environmental education at their schools, whether they had environmental education resources, and access to environmental education resources outside of school. Teachers had a different understanding of what the questions meant; and their responses varied. Some teachers indicated that they do recycling (PQT11, PQT7, PQT6 and PQT1); excursions (PQT1); one indicated that environmental education is *“delivered through the following subjects: natural sciences, life sciences and life orientation”* (PQT9). Others noted that they do not have or do anything related to environmental education at their schools (PQT8 and PQT10); *“Littering is a problem. Learners don't show any attitude of caring for the school environment”* (PQT13); *“the status of the school is not in good condition. We have leaking taps, so a lot of water is wasted”* (PQT12). In identifying the environmental resources available at their schools four teachers listed rubbish bins as a resource they have (PQT1, PQT7, PQT11 and PQT13). These extracts indicate that teachers have an opportunity to use some of the environmental issues in their schools to expand on some of the topics such as “Conservation of the ecosystem”. They can convert some of the resources to achieve their valued beings and doings.

5.2.3. Social conversion factors

5.2.3.1. Language barriers

From the profiling questionnaires, all the teachers indicated English as a language of instruction in their schools. Only two teachers, PQT3 and PQT7, indicated both English and Afrikaans as mediums of instruction. Again, the first language of the majority of learners was Setswana, except for one school where the majority of learners are Afrikaans speaking. PQT2 and PQT9 indicated that language (English) is a constraining factor in teaching NS generally, including environmental topics. In a follow up interview T2 said *“The challenge that I have in teaching environment topics is the topic of adaptation, and the concept of extinction. I think language always plays a role. It is a problem for me when I have to explain to them in terms that they can understand”* (PLOIT2). In addition to that another teacher said:

“Eish. Our learners don't really show that they understand when you teach them. So sometimes it's difficult for me to teach in a way that is easy for them. Like I know what to teach but delivering it to these kids... you ask them things like “what is

conservation?” it sound like something they have never heard before. You need to explain in Setswana for them to understand” (PLOIT1).

Both teachers explained how language is a constraint in teaching environmental topics. From the classroom observations, I observed teachers switching from English to Setswana when explaining or emphasising some of the concepts (LO1T1, LO2T1, LO1T2 and LO2T2).

5.2.3.2. Resources and textbooks

From the questionnaires and interviews one can deduce that lack of resources in schools is a major constraint to effective teaching of environmental topics in Natural Sciences. PQT2 and PQT8 indicated that they lack resources and textbooks. PQT2 stated that “...*another thing is lack of enough resources. I need charts, videos*”. She further said “*I would love to have got help with teaching materials that are interactive like videos, for leaners to see how different animals adapt to the environment*”. PQT10 wrote that their school laboratory is not functional therefore they struggle with doing experiments.

One teacher (PQT9) also mentioned that not having field trips for learners is a constraint in teaching the topic of interactions and interdependence. Another example, PLOIT1 stated that “*For that topic ... I wish I could get help and take them to Mafikeng Game reserve so that they can see what conservation means and learn more*”.

Regarding the issue of textbooks I also noticed that there was a shortage because in both classrooms learners were sharing textbooks. In some cases it was three learners sharing one textbook. When I interviewed one of the teachers she explained as follows:

The number one challenge is textbooks. I think you saw that my learners had to share textbooks, right? But the truth is we do get textbooks, but what I realised is that our school’s retrieving system is not in place. Last year we received new books, and they were enough for all learners. But in December they didn’t all return the books. We struggle to get them back. So now they have to share, some are even sharing the books in threes. (PLOIT2)

5.2.3.3. Support

In the questionnaires, teachers were asked of the support that is available for them regarding their teaching. In responding to the question of support available at school level, some teachers indicated that they are supported in terms of monitoring of teaching and learning (PQT1, PQT5, PQT8, PQT9, PQT11, and PQT13); provision of resources (PQT2, PQT4, PQT6); hiring

qualified teachers (PQT3); and discipline (PQT5, PQT10). The support teachers are getting from their schools is mainly on general curriculum issues. Most of them see meetings with parents and learners to discuss learners' performance as a form of support. Two teachers PQT7 and PQT10 said they do not receive enough support. However, teacher PQT10 indicated that he receives a lot of support from his science department. PQT2 also noted that she has a senior mentor teacher who assists her in any challenge she has relating to the subject matter.

In follow up interviews one teacher said that the support she receives is “...*not specifically for how I teach. It is for monitoring learners' progress. We hold meetings to discuss general matters relating to curriculum – like how far we are with the ATP [Annual Teaching Plan], assessment and pass rates. This is done by the SMT [school management team]*”. (PLOIT1)

The other one also said “...*We do hold Science Department meetings where we discuss some of the things we are struggling with. I also work together with other science teachers in the school*”. PLOIT2

Teachers were also asked whether they receive support from the Department of Basic Education. Their responses were focused on three areas of support – resources, curriculum and workshops. PQT3 and PQT7 indicated that they get science kit boxes from the Department. PQT8 wrote: “*The department does provide us with textbook and other basic school needs*”, and PQT12 added by saying “*The Department has been trying in terms of providing the school with textbooks and science kits for the lab*”. Some of the teachers (PQT1, PQT6, and PQT9) indicated workshops as a form of support from the Department. However, some of the teachers felt that the workshops offered by the Department are not enough. For example PQT5 said “*Not enough support because we have workshops once a term, for an hour*”, and PQT11 said “*Not as desired. The Department only offers workshops, and they are not enough*”. Two of the teachers indicated that they were not getting enough support in matters of curriculum. PQT4 wrote “*I don't see any support from the Department because they are failing to provide curriculum facilities and sport facilities*” while PQT13 said “*I feel like I don't get enough support from the Department particularly for NS. I need the subject advisor to keep guiding me*”.

5.2.3.4. CAPS Policy document

From the post-lesson observation interviews conducted with the two teachers, it emerged that the teachers had never attended CAPS training workshops for Natural Sciences. One teacher said “*No. Never heard of such training. I have been attending PSFs only*” (PLOIT2); while the

other one said “for NS no. But when CAPS was introduced I attended a workshop for Life Sciences” (PLOIT1), she further said “it was helpful because we were informed of some new topics that were introduced, especially on topics of environmental topics; but they did not go into details” (PLOIT1). When I asked the teachers how they decide on teaching methods for their lessons, one of the teachers said:

“Since I am still new in teaching, I rely on the CAPS work schedule. It kinda [kind of] guides one on how to teach each topic. There are suggested activities and practicals or demonstrations. So I go through it when I do lesson preps”. (PLOIT2)

The response suggests that the teacher found the CAPS document to be an enabling factor in her lesson preparations and teaching.

In the PSF the subject advisor used the CAPS document during one of her presentations in orientating new teachers about the subject. She kept referring to it in most of her presentations. Again, when teachers were in the group activity of setting up practical tasks for assessment they kept referring to the CAPS document to check the skills that need to be assessed in a practical activity. One of the practical tasks was for the environmental topics – ecosystems.

The descriptions and extracts above demonstrate that the CAPS document is an enabling social conversion factor for teachers. Also as discussed in section 2.7.1, the Natural Sciences CAPS document has some predetermined implied capabilities embedded within it.

5.3. Conversion factors related to teachers’ valued beings and doings related of belonging to the PSF

This section presents data which reveals conversion factors related to teachers’ valued beings and doings related to belonging to the PSF, which were described in section 4.5. The structure of this section was guided by the organisation of data according to the following conversion factors: personal conversion factors, social conversion factors, and environmental conversion factors from Robeyns (2005).

5.3.1. Personal conversion factors

5.3.1.1. Passion for the subject

It emerged from the data that teachers identified their passion for the subject as an enabling factor to participate in the PSF for professional development. For example one teacher said “*I love being a teacher. I am passionate, so that’s what drives me...*” (RQT1); and another one said “*my passion for teaching and learning*” (RQT8). Other teachers also shared the same sentiments (RQT9, RQT10 and RQT12).

5.3.1.2. Acquisition of knowledge and skills

Teachers noted the need to gain knowledge and skills in teaching NS as an enabling factor. One teacher said what enables her to participate in the PSF is “*I always want to stay up to date with current educational issues and learn more, to become a better teacher and improve on my skills*” (PQT7). Another one said “*I want to have more knowledge and ability to teach NS the best way I can*”. (PQT11)

5.3.1.3. The need to develop oneself

Linked to teachers’ need to gain knowledge and skills was the desire to develop themselves professionally. One teacher said it is “*the constant need to improve oneself and the need to want my kids to pass and understand the subject matter*” (RQT2). Another one said “*... I want to see myself growing professionally*” (RQT10). Other teachers also identified this as an enabling factor for them (RQT13 and RQT6).

5.3.2. Social conversion factors

5.3.2.1. Roles and participation in the PSF

Teachers’ participation in the PSFs is very important (see section 2.6.3). During the observation of the PSF teachers’ participation was limited. In the questionnaires teachers noted that they do not have active roles or participate to the full extent they would like to in the sessions (PQT3, PQT7, PQT8, and PQT10) (see section 4.5.1). For example, one teacher noted that they only need to show up at the session and listen to the subject advisor (FIT13). Based on the responses provided by teachers (FIT1, FIT6, FIT11 and FIT13) it became clear that the subject advisor leads most sessions all by herself. This is a constraining factor to teachers’ development as one teacher noted “*In the PSF there are no activities that offer one a chance to play an active role.*” (PQT11)

Teachers also noted that not having different facilitators or workshops by different organisations is a constraining conversion factor (RQT12, RQT7, and RQT6). For example, one teacher wrote “*there are no(t) enough professional development programmes for teachers, or maybe they are there but not easily accessible*” (PQT7); and another noted “*We don’t get workshops from outside organisations*” (PQT8). Emerging from the extracts above by PQT7 and PQT8 is that for teachers’ professional development needs to be met, there is a need of a variety of facilitators in the PSFs.

5.3.2.2. Duration of PSF sessions

Another aspect that was of prominence to teachers was the duration of PSF sessions. PSFs are normally conducted after school hours, but at times they are held during school hours. Teachers expressed that the PSF sessions are not sufficient and that the time they spent in the sessions is also not enough (PQT1, PQT7, PQT8, PQT9, PQT11 and PQT12). This emerged as a social conversion factor that constrains teachers’ engagement in content discussions as one teacher indicated: “*if the Department can schedule PSF meetings during school holidays to allow us more time to engage in content discussions and other issues. 2 hours is not enough*” (PQT7). Another teacher wrote “*They should increase the workshop time maybe to 3 hours. Also if the workshops were held during school holidays so that they don’t interfere with teaching time*” (PQT12). It was also evident that PSF sessions which are held during school hours affect their teaching time at school. This was noted by one teacher who commented on the questionnaire as follows: “*A lot of time, it’s spend talking about admin and not really breaking down content. Attending workshops takes time away from teaching and pushing content and no time is allocated for that missed period or class. You as a teacher need to figure it out*” (PQT4). The PSF session that I observed lasted for about two hours. The above extracts are evidence that the timing and duration of PSFs are constraints to teachers.

5.3.2.3. Teaching and learning resources

Teachers valued having enough materials for teaching and learning (RQT6, RQT8, RQT10, RQT11 and RQT13). For example teacher RQT1 wrote “*... and provide us with some hand-outs for future use*”; another said “*we need more workshops that deal with content and supply past question papers that have been written and then us teachers we break it down and come up with ways to improve our subjects*” (PQT2); “*I shall need prepared slides and practical investigation of the whole term that are related to my topic*” (RQT4). It is evident that teachers see access to and availability of teaching resources as an enabling factor in teaching NS.

5.3.2.4. Activities in the PSF

Teachers elaborated at length on activities taking place at the PSF, and how they benefit or do not benefit from them (see section 4.5.2). There are teachers who commented that presentations by the subject advisor take up much of the time, and they do not find the presentations beneficial (PQT3, PQT5, PQT6, FIT6 and PQT12). These presentations are mainly focussed on administration and orientation of new teachers. For experienced teachers, these presentations are a constraining conversion factor (PQT3, PQT7, PQT9 and PQT12). One teacher responding to the question of challenges they experience in professional development noted that *“workshops are mostly aimed at empowering beginner teachers”* (PQT3), and further said in an interview *“About 80% of the time is spent on admin issues. I don’t benefit from that unless there are new requirements”*. There are, however, teachers who perceived the activities mentioned above as enabling conversion factors (PQT13, PQT11, PQT2 and PQT6).

The subject advisor, however, noted that to ensure that the PSF accommodates the needs of all teachers – new and experienced teachers – she holds separate sessions. She commented as follows: *“Initially, the first week I do induction to those who are teaching the subject for the very first time. From there, the following week now I take the entire group together, the old and the new teachers together”* (ISA). But from the PSF observation the session was focussed on induction, and it was attended by both new and experienced teachers.

Group discussion activities were identified as an enabling conversion factor by teachers (PQT2, PQT4, PQT9 and FIT6). They saw it as an opportunity to learn from each other, gain knowledge, and discuss subject content (see section 4.5.2.2). One teacher, however, felt that *“some teachers waste time by asking irrelevant questions”* (PQT5). Teachers (PQT1, FIT1, FIT13 and FIT11) also noted that engaging in practical activities is an enabling factor because that is when they learn the most. However, practical activities are not done often in PSF sessions (FIT11).

It is evident from the extracts above that there were activities that teachers perceived as both constraining and enabling conversion factors in their development. The analysis of the data also showed that there is correlation between teachers’ perspectives of the PSF activities and their number of years in the PSF. When talking about presentations given by the subject advisor in the PSF, teachers who did not find them beneficial were those who have many years in teaching NS and in being part of the PSF. For example, teachers T3 and T12 have more than 10 years in the PSF. Teachers T5 and T6, with 1 and 3 years in the PSF found the presentations

beneficial. Similarly when commenting about the activity of administration in the PSF, teachers with more years in the PSF indicated that it did not benefit them anymore.

5.3.3. Environmental conversion factors

5.3.3.1. Learning space

In the follow-up interviews, the four teachers were asked if they find PSF to be a good space for the professional development as NS teachers. Three of the teachers who were interviewed (FIT13, FIT6, FIT11) said the PSF is a good learning space because it allows them to work together as teachers. They also said it is in the PSF that they can learn together and gain knowledge. But T13 also indicated that at times the PSF is not a good learning space because they spend most of the time doing nothing that develops them (FIT13). Another teacher noted that for novice teachers the PSF is good because they gain a lot of knowledge in terms of the requirements of CAPS, assessments, and administration (FIT11). Only one teacher (FIT3) said she did not find the PSF a good learning space. This is what she said: *“Not anymore. The meetings are mainly aimed at empowering beginner teachers. They are now becoming less and less relevant for us experienced teachers”*. I asked the teacher to elaborate on what she meant by PSF becoming irrelevant and she explained saying *“the focus is centred on admin. For someone who has 18 years’ experience in teaching NS, admin is something I have mastered. There needs to be a balance between activities done in the PSF to accommodate everyone, and to ensure that we all have our professional development needs met”*. (FIT3)

Also in the questionnaires teachers identified the PSF learning space as a challenge. Teacher PQT11 wrote *“The PSF workshops are not specific in terms of areas of development. They are too general”*; while teacher PQT10 wrote *“There is not much variety in the development activities. They don't introduce anything relevant and interesting”*. Other teachers highlighted that they want the PSF to *“have a variety of activities...”* (RQT13); *“the PSF need something different ...”* (RQT12); *“we need different settings of the PSF. Fresh and innovative ideas for teaching NS”* (RQT10). More evidence of whether or not teachers found the PSF as good space for learning is captured in Appendix W2, where teachers elaborated on how they would like the PSF to be structured to benefit them.

In section 4.5.4 teachers’ reflections on their expectations of the PSF was discussed. It emerged that teachers who have been in the PSF for many years are the ones who said they no longer had any expectations. Teachers T8, T10, T12 and T3 who have been in the PSF for 9, 8 and 10

years respectively, indicated that they no longer had expectations of the PSF because there is no variety in activities done in it.

Besides being a learning space, other teachers found the PSF to be a space that enabled interactions amongst teachers (RQT4, RQT7, RQT9 and RQT13). However, one teacher who was attending the PSF for the first time wrote that his challenge was “*not being able to open up to someone for the first time you meet them*” (PQT4). When he responded to the question of what enables him to participate in professional development activities he further wrote that “*the way of approach of educators made me feel they were open to me*”. Then in the reflections on what he has benefited from the session, he wrote “*interactions and learning from other teachers ...*” (RQT4). It shows that the teacher’s constraint of not being able to open up was converted into an achieved functioning by how other educators interacted with him.

5.3.3.2. Physical space where the PSF is held

The PSF was held in one of the schools which are situated in the urban areas. A classroom was used to accommodate teachers, and the space was too small to allow movement around the classroom. There were no displays on the wall, or a station where teachers could collect the materials from. The sitting arrangement also did not promote a space for engaging in discussions or working in groups. Teachers were sitting in pairs, with all the desks facing the front where the subject advisor was sitting. It was only towards the end of the session, when teachers had to do group work, that they changed the sitting arrangement and sat in groups. The space was a constraining conversion factor in that session.

From my observation also, I noticed that the venue itself was a constraint. There were some teachers who travelled a very long distance to attend the PSF. These are teachers from schools which were previously falling under a different sub-district, but were changed after the restructuring of the sub-districts in the province. Those teachers had to leave before the end of the session to catch buses back to their places. This was a constraint because they could not participate in the group activity which was done later on.

5.4. Conclusion

In this chapter I presented the data generated from interviews, questionnaires and PSF observations. The findings in this chapter provided an account of conversion factors related to teachers’ valued beings and doings in teaching environmental content in Natural Sciences, and

in belonging to the PSF. It was evident that although teachers had similar valued functionings, they needed different mechanisms to achieve them.

In the next chapter the findings from this chapter are discussed in more depth in relation to the literature review presented in chapter 2.

CHAPTER 6: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

6.1. Introduction

In Chapter 4 a detailed description of the data was presented in a narrative form, drawing from extracts of the raw data which were collected using the methods in Chapter 3. Chapter 5 gave a more detailed account of the data, using the capability approach. In this chapter, the findings in the preceding chapters are discussed in relation to the literature. The discussion makes use of analytical statements which are in line with the key research questions.

Sub-question 1: How is the environmental content in the Life and Living strand in Natural Sciences taught in classroom?

- **Analytical statement 1:** Teachers have gaps in their environmental content knowledge, and need support in using different pedagogical strategies.

Sub-question 2: What functionings do teachers value most in teaching environmental content knowledge in the Life and Living strand in grade 8 Natural Sciences and what conversion factors are associated with these functionings?

- **Analytical statement 2:** Teachers need adequate resources and support to enable effective teaching and learning.
- **Analytical statement 3:** There are various conversion factors that enabled and/or constrained teachers' valued functionings in teaching environmental content.

Sub-question 3: What are teachers' valued functionings in the Professional Support Forum and what conversions factors in the Professional Support Forum are associated with these functionings?

- **Analytical statement 4:** Teachers value having shared leadership roles and responsibility in the PSF.
- **Analytical statement 5:** Teachers valued the functioning of discussing subject content in the PSF.
- **Analytical statement 6:** Time can be a constraining conversion factor in expanding teachers' content knowledge.
- **Analytical statement 7:** PLCs have the potential to promote collaboration, as well as individual and group learning.

Sub-question 4: How can the Professional Support Forum provide teachers with experience to develop knowledge and skills needed to engage learners when they teach environmental content in the Life and Living strand in grade 8 Natural Sciences?

- **Analytical statement 8:** For PLCs to be effective, they should align with teachers' valued beings and doings.

6.2. Analytical statement 1: Teachers have gaps in their environmental content knowledge and need support in using different pedagogical strategies.

As discussed in Chapter 2, the CAPS curriculum introduced a curriculum which is strongly content-referenced, and requires active and critical approaches to learning, and to environment and sustainability content (see section 2.2). With the introduction of environmental content in the curriculum, it means that there is a need for collaboration of content and pedagogy (Thomas, 2005 – section 2.3). It becomes a challenge for teachers because they are expected to possess the new content knowledge and new pedagogical approaches (Fundisa for Change, 2013 – section 2.3).

Findings from this study showed that teachers had gaps in their content knowledge. The evidence is from what the teachers expressed in an interview regarding environmental topics. One teacher mentioned that she needed support from the subject advisor, and needed to learn more about the topic and have the confidence of teaching it. The other one said *“Maybe if they made it possible for us to register for short courses like Nature Conservation, so that we increase our knowledge in those topics. Or they could also help us affiliate with certain programmes that can help us develop us in our teaching and get more knowledge”*. The same sentiment was shared by another teacher who said when it comes to environmental topics she has to read more and learn some of the concepts (see section 5.1.1.1). The statements made by the teachers show that there are still challenges with teachers' in-depth knowledge in environmental content as pointed by other researchers (Lotz-Sisitka, 2011; Songqwaru, 2012; Chitsiga, 2016; Tshiningayamwe, 2016 – Section 2.5.1). The gaps in the teachers' knowledge were not only because of the new content knowledge in the subject, but could be attributed to other factors (discussed in Analytical Statement 3 – section 6.4).

With the new environmental content knowledge, teachers need to use different pedagogical approaches to support change –oriented learning towards better environmental sustainability practices (see section 2.3). Riordan and Klein (2010) also emphasised the importance of environmental education pedagogy which differs from the traditional pedagogical approaches,

in that it is grounded in a view that teachers should use creative and dynamic processes to engage learners (see section 2.3). During classroom observations, and through interviews and questionnaires teachers indicated the pedagogical approaches they use in their teaching. The two teachers who were observed in classrooms reflected on how they decide on the methods they use in teaching environmental content in Grade 8 Natural Sciences. One (T3) indicated that she relied on the CAPS work schedule because it has guidelines on activities teachers can do, while the other (T2) admitted that she uses prior experience (see section 4.3.1). The Natural Sciences CAPS does give a guideline of investigations, practical work and demonstrations teachers can do for each topic (see section 2.4. and 4.2.3). But it is only a guideline, teachers have to expand on that.

Data in Chapter 4 revealed that most teachers used a variety of teaching methods, but the most common one centred on information transfer approach (see section 4.3). The most common methods identified by teachers and observed in their classrooms were questioning, discussions and teacher-centred method (which teachers referred to as direct or traditional teaching) (see section 4.3.3). The questioning and discussion methods seemed to encourage learner participation in a lesson to a certain extent (see section 4.3.3.1). During lesson observations, learners participated only when answering the teachers' questions and when writing notes or classwork. Using one method in teaching is not helpful because it limits the extent to which learners can fully participate during the lesson. It proves what Rosenberg et al. (2008) and UNESCO (2012) emphasised, that teachers' ability to use a variety of methods is critical for working with learners' diverse needs and abilities. Learners' participation is influenced by their different learning styles; they respond better to processes that fit them (see section 2.3).

The study also found that teachers were willing to use other methods such as fieldtrips, excursions and outdoor lessons. One teacher who was observed teaching in the classroom, said the following *"I enjoy teaching it but I want to get learners to be able to relate to it. I wish I could get help and take them to Mafikeng Game reserve so that they can see what conservation means and learn more"*. This shows that teachers are aware that environmental topics need to be practical, but due to some constraints they are not able to take learners to the field trips (see section 4.4). This resonates with what Riordan and Klein (2010) pointed out that environmental education pedagogy should include activities such as active investigation and hands-on activities. This is also emphasised by Rosenberg et al. (2008) who have identified five pedagogical approaches, among which fieldwork, excursions, and fieldtrips are key (see section 2.3).

Teachers identified some of the constraints to doing outdoor lessons. The study found that one of the constraints is the schools' environment. Teachers did not find their schools' environment conducive for outdoor lessons. One of the teachers said he does not do outdoor lessons because the school does not have things like flower garden or trees. Although teachers did not directly say this, but it is evident that lack of outdoor lessons or hands-on activities might have negative effects on how learners grasp some of the environmental concepts. There are teachers who noted that their learners struggled to understand or relate some processes in the topic of interrelations and interdependence in the environment. For example one teacher (T4) stated that his learners fail to understand the relationship between biotic and abiotic factors (see section 5.1.1.1). To enhance learners' understanding of environmental content, teachers have to do practical work or investigations with learners; it is a requirement of the CAPS curriculum. Specific Aim 1 of Natural Sciences says "*learners should be able to complete investigations, analyse problems and use practical processes and skills in evaluating solutions*" (see section 2.4). Also in the guideline of activities that teachers can do in the topic of ecosystems, there is a suggested activity of taking learners to the school ground as an investigation.

Although teachers had noted in the questionnaires that they have some environmental activities going on in their schools, none of them made any links of those activities to their teaching. This is what the capability approach looks at – the people's ability to convert the resources they have into functionings (Sen, 1999). It is further reiterated by Walker (2005) who pointed out that capability approach is about what people can actually do, rather than what resources they have access to (see section 2.7.1). Three teachers indicated that - as their valued beings and doings - they would like to do outdoor lessons, and find ways of relating the topic to real local environmental issues (see section 5.1). In section 5.2.1, teachers identified activities such as recycling and environmental campaigns; others noted environmental problems such as leaking taps and littering in the schools' yards. Teachers could integrate these into their teaching as part of practical work and investigation, and actively engage learners in making links with the environmental topics they learn in classrooms. They could also start environmental clubs and work with learners to develop the school grounds as a teaching and learning resource. This is what the NS CAPS (D1) aims, to produce learners that are able to "use science and technology effectively and critically showing responsibility to the environment and the health of others" (see section 2.4).

Another finding from the study which I find important to highlight although it is not the main focus of the study is the assessment of environmental topics. As mentioned in section 4.3.3.5,

teachers used different assessment strategies during their lessons. But it seemed like the kind of questions asked were mostly clustered under the first cognitive level (knowing science). The verbs used often were: ‘state’, ‘list’ and ‘define’; which are all used when setting low order questions. The assessments, although they were informal, did not cover a range a cognitive levels, or assess learners’ different skills and abilities as stated in the NS CAPS document (see section 2.4).

The second constraint to doing more practical activities is lack of resources. Teaching strategies that teachers use in the classroom are mainly dependent on the availability of resources.

6.3. Analytical statement 2: Teachers need adequate resources and support to enable effective teaching and learning.

In the profiling questionnaire, teachers were asked to identify the resources they use in their teaching, and all of them noted that they used textbooks. It was only a few who said they also use PowerPoint presentations through laptops and projectors (see Table 4.2 - section 4.3). It emerged that teachers valued being supported with resources for teaching and learning. Some of the resources they identified are videos, charts, other interactive materials, even materials for assessment such as past question papers and worksheets (see Appendix W2). Teachers pointed out that they have lack of resources and they said that it was a challenge for them. Most of them said they do not do practical work during their lessons because of lack of resources. The main lack was of textbooks. In the lessons observed, it was noted that there was a shortage of textbooks. Learners had to share textbooks; in other classes more than two learners shared a textbook (see section 5.2.3.2). When the teacher was interviewed after the lesson she explained that the school does get textbooks, the problem is their poor retrieval system. The NS CAPS document is very clear on the matter of textbooks. It says “every learner must have his or her own textbook. Teachers should ensure that a system is in place for recovering textbooks at the end of every year. Schools must provide secure storage space where textbooks and other equipment can be stored (D1, p. 12 – see section 4.2.3).

Some teachers indicated that their school laboratories are dysfunctional, therefore they are unable to do experiments. But the CAPS document clearly highlights that schools have to ensure that essential equipment is provided; and in cases where the equipment is limited teachers should improvise than not to do practical work at all.

It also emerged from the study that teachers perceive support from the Department of Basic Education [the Mahikeng sub-district] differently. There are teachers who felt that the

Department is supporting them through the provision of textbooks, science kits, and other basic school needs. But most teachers felt that the support from the Department of Basic Education is not adequate. They indicated that the workshops offered by the Department are not enough in terms of the frequency and duration. Furthermore, there is no sufficient support from the subject advisor in terms of the teaching of NS (see section 5.2.3.3). The ISPFTED clearly states that it is the role of the Districts to support PLCs with resources and expertise on facilitation skills, development of teaching resources, and the use of ICT (see section 2.6.4). Teachers need support in teaching environmental content, and with resources as well. This is supported by Songqwaru (2012); Isaacs (2016); Tshiningayamwe (2016) who indicated that there is a need for teachers to be supported to enhance their teaching practices and biodiversity knowledge.

6.4. Analytical statement 3: There are various conversion factors that enabled and/or constrained teachers' valued functionings in teaching environmental content.

According to Robeyns (2005) there are different personal, social and environmental conversion factors that can enable or constrain teachers' functionings. Most of the teachers' valued beings and doings in teaching environmental content have been discussed in detail in Analytical statements 1 and 2, as well as some of the conversion factors. There are other enabling and constraining conversion factors that were evident in the study.

6.4.1. Teachers' qualifications and experience.

Table 5.1 in section 5.1.1.1 captured teachers' qualification together with their experience in teaching Natural Sciences. Most teachers were qualified to teach Natural Sciences, and they identified that as an enabling factor. Lack of appropriate qualifications were a constraining factor. One teacher said "*...I don't know the content knowledge. I have to teach myself before I go to class. I'm not qualified for it but because we don't have enough science teachers I had to take it*" (see section 5.1.1.1). The teacher had to teach NS because of shortage of teachers. The school's system did not give the teacher the freedom to choose what he valued doing and being, as explained by Walker (2005) in the capability approach (see section 2.7.1). It is evident that schools' contexts can be social constraining factors to teachers' capabilities.

Some teachers, though they had relevant qualifications, identified their experience as a constraining factor. One teacher noted "*I know the content because I majored in Life Sciences, but teaching it is not easy. I just wish they will not move me from Grade 8 again next year because it would help me to master the content and gain confidence in teaching*" (see section 5.1.1.1). This shows that professional learning communities need to take into account the

realities of the schools' contexts and individual teachers' needs and experiences, and focus on building teachers' skills and competencies (see section 2.5.1)

The study also showed that having novice and experienced teachers in the same school could be an enabling factor for teachers to expand their capabilities in their practices. In section 5.1.1.1, two teachers pointed out that they work with other teachers in their schools. One of the teachers, who has 23 years' experience in teaching, pointed out that she has started using a computer in her lessons because there are young teachers who are helping her. Although this was not in a PLC setting, it shows that collaboration can make teachers learn from each other. Therefore having experienced and novice teachers in a professional learning community can be a benefit for teachers irrespective of their teaching experience.

6.4.2. Learners' interest and participation

It also became evident from the study that teachers perceived that learners lacked interest in learning environmental topics, and did not fully participate in the lessons (see section 5.1.1.3). But this can be attributed to the fact that teachers do not use pedagogical approaches that promote learner participation (discussed in Analytical statement 1 – section 6.2). This corresponds to UNESCO's (2012) view that learners respond to teaching methods that fit them (section 2.3). It is therefore imperative for PLCs to focus on developing teachers' valued functionings of learning new teaching strategies that would respond to how learners learn.

6.4.3. Overcrowded classroom

The findings of this study also show that overcrowded classrooms are a social constraining factor in teaching. Teachers pointed out that having large numbers of learners in their classrooms constrains them from doing experiments, and from giving learners individual attention (see section 5.2.1). Overcrowded classrooms lead to inadequate resources being available for learners, for example, textbooks and desks, this was evident during classroom observations. Therefore professional development programmes should take into account the contextual realities within which teachers and learners live and work (Du Toit & Sguazzin, 2000 – see section 2.5.1).

6.4.4. Language barrier

It also emerged from the study that language is a constraining factor in teaching environmental content. A majority of the schools in the study had English as a second additional language. One of the teachers said this in an interview *“The challenge that I have in teaching environment topics is the topic of adaptation, and the concept of extinction. I think language always plays a role. It is a problem for me when I have to explain to them in terms that they can understand”* (PLOIT2). This was echoed by another teacher (PLOIT1) who said her learners do not show that they understand when she teaches, and she has to explain in their home language (Setswana). This implies that teachers have to teach more than just the content, but also focus on developing learners’ cognitive skills. The CAPS document emphasises the development of learners’ cognitive skills, which includes reading and writing (see Table 2.1 – section 2.4).

6.5. Analytical statement 4: Teachers value having shared leadership roles and responsibility in the PSF.

It was revealed in the study that teachers valued being actively involved in the PSF, but they are not given more opportunities for participation. One teacher (PQT10) noted that he preferred that teachers be allowed to come up with their own points of discussions, while another one (PQT8) concurred with him in saying teachers should be given an opportunity to say what they want to discuss. Although teachers were observed participating in a group activity, most of them do not consider that as an active role (PQT1, PQT1, PQT7, PQT8, and PQT10). This was supported by a response made by one teacher in an interview who said *“in the sessions I have attended we have most of the times been recipients. But we do engage in discussions at times. In some sessions we do practicals together that we are supposed to do with learners. But I wish it happened often because I learn the most when we do these kind of activities”* (FIT11 – see section 5.3.1). In another interview with a different teacher the same sentiment was reinforced, *“We teachers don’t do anything big. We only need to show up with whatever the subject advisor needs from us like files and learner books. There are times we would have discussions, but it does not happen often”* (FIT13 – see section 4.5.1). But according to the ISPFED, teachers should be at the core of PLC activities, and take leadership roles (see section 2.6.2). Professional learning communities should offer supportive conditions and shared leadership as argued by Hord (2004), teachers should be allowed to share responsibilities (see section 2.6.2). It also emerged from the data that the subject advisor is the one who always plays the role of the facilitator, and also responsible for the planning of all activities in the PSF (see section 4.5.1). The role of the subject advisor as observed in the PSF, did not demonstrate many of the

facilitator characteristics discussed in section 2.7.3. For example one of the roles of the facilitator is to understand the group dynamics. This role seemed to be lacking because the PSF session was focussed more on the induction of new teachers, but there were experienced teachers there who found the session irrelevant. Although the subject advisor did indicate in an interview that she holds different PSF sessions for induction and content discussions (see section 4.5.1), it was not evident. But this could be due to the fact that only one PSF session was observed, and could not capture all the roles of the subject advisor as a facilitator from a single session.

Teachers valued having different facilitators from outside the PSF, or even other teachers in the PSF who are good with NS. For example, one teacher (FIT11) said “*Maybe we should also be given a chance to facilitate some of the sessions, you know. With the subject advisor just sitting there and watching*” (see Appendix W2). Underwood (2007) argues that there should be shared leadership, and teachers should be allowed to share responsibilities and make decisions. The ISPFTEd also highlights that the role of the facilitator is not to impose ideas on other members and be directive, but rather to facilitate discussions and support teachers. The role can be taken up by different people (South Africa. DBE, 2011 – see section 2.6.4). This means that in a PLC teachers can and should take the role of facilitating. This is in line with the DBE (2015) guideline on PLCs, which points out that some of the teachers’ roles in PLCs is to take up leadership roles such as facilitation, setting the agenda and defining outcomes (see section 2.6.4). However, as emphasised by Brodie and Borko (2016), there is a need to prepare teachers and other novice facilitators to be proficient because as professional development efforts increase, there is a high demand of knowledgeable and skilled facilitators. The District Education Departments have a role of supporting teachers with expertise on facilitation skills (discussed in section 6.3)

6.6. Analytical statement 5: Teachers valued the functioning of discussing subject content in the PSF.

The study found that teachers value spending more time discussing subject content in the PSF. Teachers noted that much time is spent on administration than on discussing subject content (see section 4.5.3)

They further indicated that less time should be spent on administration and presentations on subject policies and requirements (PQT3, PQT11 – see section 5.2.3.4). As discussed in Chapter 2 (see section 2.5), Hinde (2003) noted that effective professional development should offer meaningful intellectual engagement with ideas, and take explicit account of the contexts of teaching and the experience of teachers. This is also supported by Du Toit and Sguazzin (2000) who noted that professional development should enable teachers to build increasingly sophisticated understanding of their work and context. A focus on environmental content discussions will enhance teachers' knowledge, understanding and teaching practice of the topic in Natural Sciences.

It should be noted, however, that administration is also an important component of activities in PLCs. The DBE (2015) guideline highlights activities such as analysis of learners' results, discussion of the CAPS documents, and analysis of data to improve learning (see section 2.6.4). But what also emerged from the study is that there is a need to separate sessions that focus on subject content from the ones that deal with administration and induction of new teachers. Teachers with more experience in teaching and have been part of the PSF for long, indicated that they no longer find the administration activities helpful and beneficial. For example T1 has 30 years' experience in teaching, and 18 in teaching Natural Sciences; and this is what she said in an interview *"About 80% of the time is spent on admin issues. I don't benefit from that unless there are new requirements..."*. Another teacher (T7) with 4 years' experience in teaching NS noted *"...Orientations are no longer that important because I am now used to how things work"* (see section 5.3.2.4).

In an interview, the subject advisor for Natural Sciences explained that she holds the induction session with new teachers only, then another session with all the teachers (see section 5.3.2.4). This is contrary to what the teachers indicated, and also what I observed in the first PSF session of the year. The PSF was attended by all teachers and was more focussed on orientation into the subject. This might have been due to what the subject advisor told me informally, that she has new teachers who previously belonged to a different district. She said the sub-district were restructured, so she had to accommodate the new teachers.

6.7. Analytical statement 6: Time can be a constraining conversion factor in expanding teachers' content knowledge.

It emerged from the study that time was identified as the main factor that constrained teachers from achieving their other valued beings and doings in the PSF. Teachers noted that the frequency as well as the duration of the PSF sessions was not enough. They wanted extended time so that they can focus on discussions in different topics in NS (see section 4.5.3). Having more time to engage in PSF activities would be an enabling conversion factor, and allow teachers to expand their content knowledge and by extension their environmental content knowledge and other functionings they value. The issue of time was emphasised in the ISPFTEd (South Africa. DHET & DBE, 2011), that time should be scheduled for teachers to participate in PLCs and engage in quality teacher development (see section 2.6.4).

6.8. Analytical statement 7: PLCs have the potential to promote collaboration, as well as individual and group learning.

Collaboration is one of the key characteristics of effective professional development (Darling-Hammond & McLaughlin, 1995). It was evident from the study that teachers valued working together. In the PSF they were given one task to do in groups, and it was evident that there was collective learning through collective knowledge creation (Louis et al., 1995, as cited in Stoll et al., 2006). Furthermore, teachers commented on this when asked about what they benefited from the PSF session. One teacher (RQT7) said “*making contact with teachers from other schools, who joined us for the first time. It means more networks for me*”, and another said (RQT4) “*interaction and learning from other teachers...*” (see section 4.5.5). Teachers used phrases such as “*learning from each other*”, “*gaining more knowledge*”, in association with collaboration (see section 5.3.3.1). This resonates with what Hipp and Huffman (2000) emphasised, that PLCs should have supportive conditions that allow time for collaboration, empowering teachers, and reducing isolation. This is also supported by Villegas-Reimer (2003) who noted that teacher networks promotes collaboration among teachers, to work on problems they experience in practice (see section 2.6.3). Supportive PLCs create a climate that encourages sharing teaching strategies and trying new strategies (see section 2.6.2).

One of the characteristics of PLCs is mutual trust. Although in the entire study this was voiced by only one teacher, it is important to highlight it. The teacher (PQT4) noted in a questionnaire that meeting the teachers in the PSF for the first time, it was not easy being open. But responding to a question of what enabled him to participate, he said “*the way of approach of*

the educators made feel free. They were open to me” (see section 5.3.3.1). It is evident that PLCs provide opportunity for interactions among teachers, together with relationships of trust and identity (Jita and Ndlalane, 2009 – see section 2.6.3).

6.9. Analytical statement 8: For PLCs to be effective, they should align with teachers’ valued beings and doings.

Teachers’ valued beings and doings both in teaching environmental content and in belonging to the PSF, have been detailed in sections 4.4 and 4.5. Teachers valued being supplied with teaching and learning materials (discussed in Analytical statement 2), being supported at school and by the subject advisor, learning new teaching strategies and gaining more knowledge of the environmental topics (see section 4.4). Relating to the PSF teachers valued having the freedom to have a say on what they want to discuss in PSFs, facilitating, having sufficient time to discuss subject content, and collaborating with each other. They reflected on what they benefited or did not from the PSF, as well as how they would like the PSF to be structured (see sections 4.5.4 and 4.5.5).

Therefore, for PLCs to be effective in developing teachers, should consider what teachers value and incorporate that in the activities of professional development. This resonates with what Robeyns (2005) argued when she said evaluations and policies should focus on people’s capabilities and functionings, on the quality of their life, and on removing obstacles in their lives so that they have more freedom to live the kind of life that, upon reflection, they have reason to value (see section 2.7.1). Removing obstacles in teachers’ lives would mean finding a way of minimising the constraining factors teachers have identified, and providing them with opportunities of freedom to expand their capabilities in teaching environmental content, as well as improving their classroom practices in general. That is what the capability approach is about: freedom and development of environment suitable for human flourishing (Robeyns, 2005 – see section 2.7.1).

6.10. SUMMARY OF THE STUDY

As presented in Chapter 1, the overall aim of this study was to explore how professional learning communities can contribute to the development of teachers’ capabilities and achievement of their valued functionings in teaching environmental content in Grade 8 Natural Sciences. This study was a local case study of a professional support forum of Natural Sciences in North West, in the Mahikeng sub-district.

According to the eight analytical statements presented in sections 6.2 to 6.9, it emerged from the study that the Natural Sciences teachers who were part of the PSF had gaps in environmental content knowledge. There are various personal, social and environmental conversion factors that are associated with these (qualifications, experience, and lack of support).

Findings also revealed that teachers in the study were not familiar with teaching methods that can be used in teaching environmental content. The two main constraining factors that were identified were lack of resources and schools' physical environment which does not allow for outdoor lessons. Other factors that were attributed with how teachers taught environmental content in classrooms were large classroom sizes and language barriers.

Part of the study was looking at teachers' valued beings and doings in belonging to the PSF, and the conversion factors related to those. The study found that teachers valued active participation in the PSF sessions, taking leadership roles and responsibility, discussing subject content, learning new teaching strategies from each other, and being provided with learning and teaching resources. The study also found that there are a number of constraining and enabling conversion factors in the PSF, amongst them are time and duration of the PSF, activities in the PSF, learning space, teaching and learning resources, and facilitation.

6.11. RECOMMENDATIONS

This section draws from the findings of the study to make recommendations on how professional learning communities can contribute to the development of teachers' capabilities and achievement of their valued beings and doings in teaching environmental content. It should be noted that insights from the study are unique to this particular PSF, and should not be generalised to the broader landscape of PLCs. But these recommendations might be useful for further research on PLCs, and other teacher development programmes in South Africa. These might also be helpful in the process of establishing PLCs through the already existing PSFs. As evident from the study, the PSF under study had some characteristics similar to what PLCs are; therefore the Department of Education could look into how they work with the PSFs to strengthen them so they can function as PLCs. The recommendations are presented below.

The study recommends that teachers' professional development programmes should:

6.11.1.Promote subject content discussions and group, as well as individual learning.

The finding from this study showed that teachers had gaps in their knowledge of environmental content. Therefore, teacher development programmes should offer teachers a platform to create knowledge collectively by providing opportunities to have in-depth discussions on subject content. These programmes should provide training for new teachers, as well as ongoing support for all teachers. More time should be allocated for deeper engagement with the environmental content, with the support of more knowledgeable facilitators. Teachers who have more years of experience in teaching Natural Sciences could also be given an opportunity to mentor novice teachers in the PSF. This will ensure that teachers who have been part of the PSF for a long time do not feel like the PSF is no longer relevant for them, as indicated by one teacher. Professional enquiry will help teachers reflect on their own classroom practices, and share with each other strategies for improvement.

6.11.2.Create supportive conditions that will expand teachers' capabilities in teaching environmental content.

6.11.2.1. Teaching and learning resources

The study showed that teachers used textbooks as their main teaching resource, and wanted to be provided with other teaching and learning resources. Teachers also identified lack of resources as a constraining factor in their teaching. Therefore, activities that are done with or by teachers in professional development programmes should allow teachers to engage with different resources that they can use in their teaching. These could be activities which involve investigations or practical tasks which teachers can do with learners in the school ground. Doing this could promote the use of hands-on activities, and also engage learners and encourage participation. Exposing teachers to different teaching and learning resources would expand their capabilities in teaching environmental content, develop their skills in using the resources, and enable them to develop materials on their own. In the Natural Sciences CAPS document teachers are encouraged to improvise when resources are not available, so this would be an opportunity for them to develop materials. Again, teachers identified their schools' physical environment as a constraining factor in teaching environmental topics. Therefore, supporting teachers to change their schools' environment would be an enabling conversion factor. Teachers can work together with learners to plant trees, start gardens and even start or improve the environmental campaigns and/or clubs in their schools. This would be an

opportunity to engage learners in hands-on activities in learning about the environment, and eventually it would help teachers to have outdoor lessons.

6.11.2.2. Familiarise teachers with pedagogical approaches that support better environmental sustainability practices.

The study also showed that teachers used limited pedagogical approaches in teaching environmental content. Therefore, the study recommends that teacher development programmes should be structured in such a way that teachers are exposed to and engage in different pedagogical approaches for environmental learning and teaching. This would enable teachers to work with learners' individual learning and diverse needs. The subject advisor can invite relevant programmes such as the Fundisa for Change to help strengthen and expand teachers' knowledge and teaching strategies in environmental topics.

6.11.2.3. Time and space for collaboration

Teachers value collaborating and having enough time to enable their professional development. The two to three hour PSF sessions are not enough to engage in all activities that would contribute to the achievement of their valued functionings. The frequency and the duration of PSF session need to be increased. Considering that the subject advisor has a lot of schools she is working with, having more PSF sessions might not always be possible. But the subject advisor, together with other relevant stakeholders from the district, can help schools establish PLCs, as indicated by the PLC policy document. Schools in the same or neighbouring areas can be grouped together; teachers can define the activities they want to engage in and meet as often as they see fit. However, this would require training for teachers who will facilitate these PLCs, and some external help. To ensure that there is some form of monitoring of these school-based PLCs, teachers could report back in the sub-district PSF sessions. However, the report back should be done as a learning process, where teachers reflect back on the learning processes (what works, what are the challenges, new strategies and so on) that transpire from the PLC sessions. School-based PLCs could also help the provincial education department to align teacher development activities with school activities to minimise loss of teaching time. Teachers from areas that are too far from where the PSFs are usually held would greatly benefit from these school-based PLCs.

6.11.3. Take explicit account of teachers' valued functionings and conversion factors that can enable teachers to develop their capabilities.

Teachers' professional development programmes should be relevant to teachers' needs, and aligned with teachers valued functionings. Teachers value activities that allow them to actively participate in the PSF. The study has shown that teachers do not want prolonged presentations by the facilitator, but they want activities that enable them to have discussions on subject content, and other issues related to their teaching practices. One of the findings is that teachers want to take active roles such as facilitating and being involved in the planning of the PSF activities. They do not want to be passive participants in professional development programmes. The study recommends that teachers should be given different roles. For example, teachers together with the subject advisor, can agree on topics that are challenging, then form groups and each group takes one topic which they will work on and present in the next session. The subject advisor as the facilitator should just offer guidance.

The findings of the study have also show that teachers value being supplied with teaching and learning resources. Not only policy documents and administration material such as lesson plans, but resources such as worksheets, practical tasks, past exam papers, and videos that they can use in their classrooms. Professional development programmes should support teachers with teaching and learning resources.

All of the teachers valued beings and doings discussed in the previous recommendations should be taken into consideration, and be aligned with the activities in PLCs. The recommendations made in this study could be used by subject advisor, the Department Basic of Education and any other responsible persons involved in teacher development programmes.

6.12. RECOMMENDATIONS FOR FURTHER RESEARCH

- There are limitations in the study. Only one PSF session was observed. Observation of two to three PSF sessions would give more insight in terms of the activities that teachers engage in, how each session is structured, and looking at patterns of the sessions. Thus provide more input in terms of what needs to happen to strengthen PLCs.
- The study could be conducted on a broader setting, where different professional learning communities in different areas (other sub-districts in the same province, or in different provinces) are studied. This would give a better representation of how PLCs contribute to the development of teachers' capabilities.

- The sample size of participants can be expanded, and more lessons observed for more insights. The same subject, Natural Sciences, could be studied but at different grades or phases.
- Although teachers were observed teaching environmental topics in the classroom, the PSF session was not focussed on environmental content topics. Therefore, the study could not make direct links on how participating in the professional development session influenced teachers' classroom practices related to environmental sustainability. The study only looked at opportunities and gaps in the PSF that could be used to improve teachers' practices. It would be valuable to observe PLC sessions with a focus on environmental topics. Nonetheless insights gained can be extended to support teachers in teaching environmental content knowledge.
- Further research should be conducted on the processes of setting up professional learning communities. The research could be done with different stakeholders involved in the process.

6.13. CONCLUSION

The study set out to explore how professional learning communities can contribute to the development of teachers' capabilities and achievement of their valued functionings in teaching environmental topics in Natural Sciences. These included, among others, being supported with teaching and learning resources, having more knowledge on environmental topics, learning new teaching strategies. The research further showed that there were some enabling and constraining personal, social, and environmental conversion factors associated with teachers' valued functionings. These included teachers' passion, qualifications, experience, learners' interest, lack of teaching and learning resources, inadequate support from the Department of Basic Education, and the schools' context.

It also emerged from the study that teachers had valued functionings in the PSF. These included being provided with teaching and learning resources, taking roles in the PSF, discussing content, and engaging in different activities. The conversion factors that relate with these functionings are time, learning space, and facilitation. The findings from this study have shown that teachers have different valued functionings in teaching environmental content, and in belonging to the PSF. Therefore, professional learning communities should respond by taking into consideration and aligning their activities to teachers' valued beings and doings. To develop teachers' capabilities, professional development programmes should provide

opportunities and space for teachers to bring their self-determined professional development needs and goals. Teachers' valued functionings and the conversion factors related to them, can be translated into enablers that can develop teachers' capabilities. PLC activities should cater for and respond to individual teachers' valued functionings. The study has explored opportunities that exist in professional learning communities, which could be used to effectively develop teachers in line with their individual professional needs for improving their classroom practices in teaching environmental content.

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APPENDICES

APPENDIX A: CONSENT FORM FOR TEACHER 1

INFORMED CONSENT FORM

Research Project Title:	An exploration of how professional learning communities can contribute to development of teachers' capabilities and valued functionings in teaching environmental content in Grade 8 Natural Sciences
Principal Researcher:	Kgomotso Thomas

Participation Information
<ul style="list-style-type: none">• I understand the purpose of the research study and my involvement in it.• I understand the benefits of participating in this research study.• I understand that there are no financial gains from participating in this study.• I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason and without any penalty.• I understand that any information gained during the study will be treated confidentially and only used for research purpose.• I understand that the research will involve classroom observations which will be video-recorded.• I understand that the interviews will be recorded electronically and written out word-for-word later.• I understand that I will be given an opportunity to read and comment on the transcribed interview notes.• I understand that the findings from this research study will be shared with me.

Information Explanation
<ul style="list-style-type: none">• I confirm that the above information was explained to me by Kgomotso Thomas and I have had the opportunity to ask questions about the study:• The above information was explained to me in English and I am in command of this language:

Voluntary Consent	
I, <u>[Redacted]</u> , voluntarily give my consent to participate in the above-mentioned research.	
Signature: <u>[Redacted]</u>	Date: <u>19 / 02 / 2018</u>

Researcher Declaration	
I, <u>Keometaq Thomas</u> , declare that I have explained all the participation information to the participant and have truthfully answered all questions asked by the participant.	
Signature: <u>[Signature]</u>	Date: <u>19 / 02 / 2018</u>

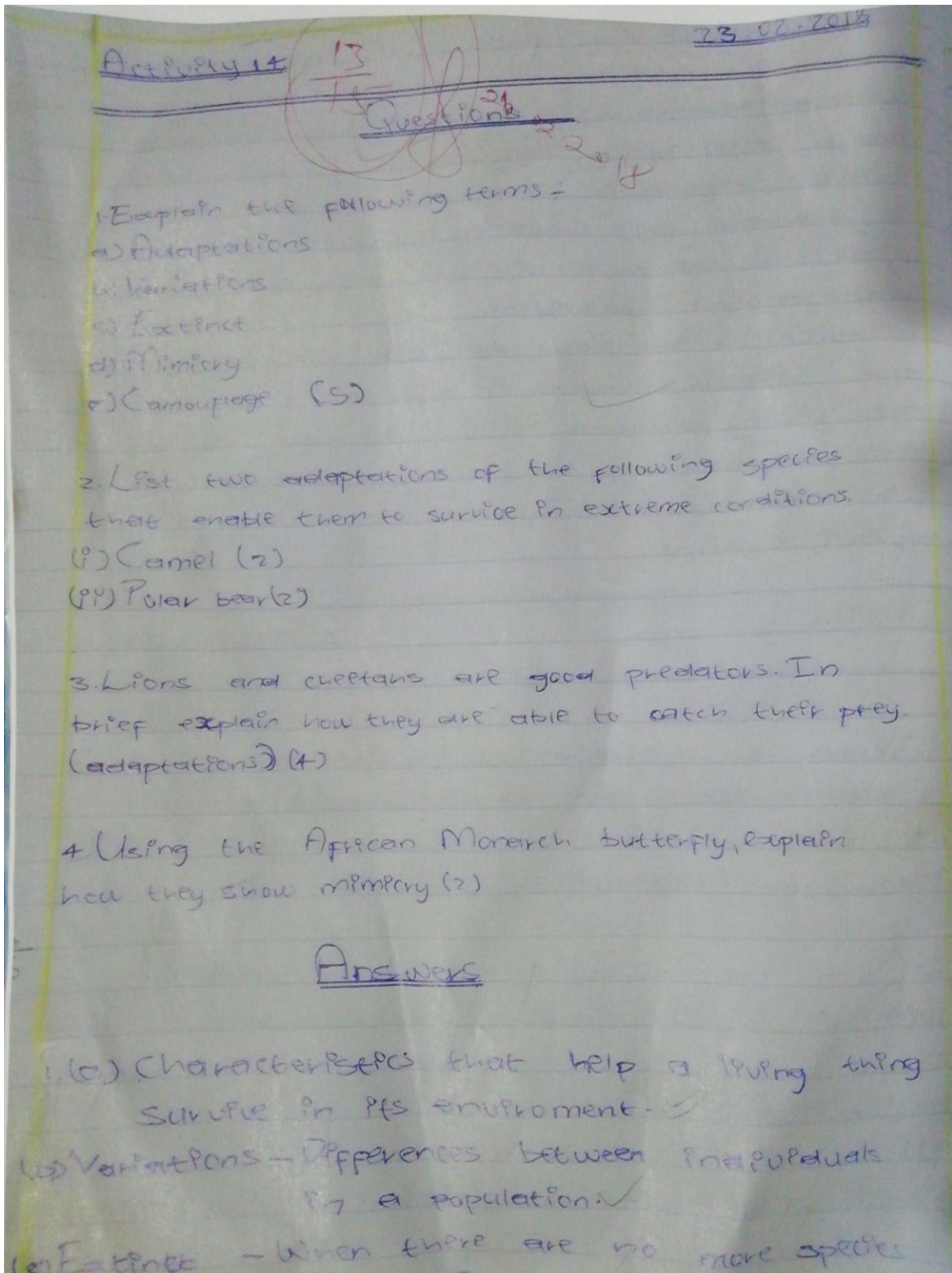
APPENDIX B1: CLASSROOM OBSERVATION Schedule [For Teacher 1]

<p><i>Lesson objectives</i></p> <p>Introduction of the EE lesson, lesson objectives, expectations from lessons about EE in lesson.</p>	<p>Teacher started lesson by recalling concepts from previous lesson of balance in the ecosystem. Lesson objectives outlined in lesson plan</p>
<p><i>Instructions / teaching methods</i></p> <p>Instructional strategies / method of presentation, nature of activities, use of EE terminologies.</p>	<p>The teacher used guided questioning throughout the lesson.</p> <p>No activities</p> <p>She used EE terminologies, and kept explaining them in home language as well done</p>
<p><i>Learners engagement</i></p> <p>Learners engaged, in what, to what extend do learners participate, teacher's role in lesson, learners encouraged to do and not to do, learners given opportunities to interact with materials and how, how are learners exposed to the teaching / learning.</p>	<p>Learners were active, answering questions. Teacher gave real-life examples to engage learners more. Learners could relate to them. In explaining adaptation, she used examples of animals that learners are familiar with, and it encouraged learners to add more examples of their own.</p> <p>Learners were given opportunity to interact with learning materials. Teacher kept referring them to their textbooks, showing them picture. She also handed out printed notes and throughout the lesson kept telling learners to underlines/highlighting some important terminologies.</p>
<p><i>Other key issues</i></p> <p>Class arrangement, size, displays, timetable</p>	<p>Number of learners in class: 58. Not enough space. Desks were well arranged, but were not enough. Other learners set in 3's. nothing displayed on the walls</p> <p>Lack of textbooks.</p>

APPENDIX B2: CLASSROOM OBSERVATION SCHEDULE [For Teacher 2]

<p><i>Lesson objectives</i></p> <p>Introduction of the EE lesson, lesson objectives, expectations from lessons about EE in lesson.</p>	<p>Teacher started lesson by continuing from previous lessons of ecosystem</p>
<p><i>Instructions / teaching methods</i></p> <p>Instructional strategies / method of presentation, nature of activities, use of EE terminologies.</p>	<p>Asking questionings</p> <p>The teacher focused on balance in the ecosystem. Drew on the chalkboard to explain some concepts (imbalance in the ecosystem, carrying capacity)</p>
<p><i>Learners engagement</i></p> <p>Learners engaged, in what, to what extend do learners participate, teacher's role in lesson, learners encouraged to do and not to do, learners given opportunities to interact with materials and how, how are learners exposed to the teaching / learning.</p>	<p>Learners' engagement minimal. Learners were unruly for most of the time during the lesson, some disrupting the teacher.</p> <p>Teacher talked alone throughout the lesson. Attempted to use local examples in the lesson. Learners given an oral test after test</p>
<p><i>Other key issues</i></p> <p>Class arrangement, size, displays, timetable</p>	<p>Number of learners: approximately 60</p> <p>No enough desks, learners sat in 3's and 4's on desks. No displays on the walls.</p> <p>Shortage of books. Learners were sharing.</p>

APPENDIX C1: EVIDENCE OF LEARNERS CLASS ACTIVITY



(vi) Mimicry - When one harmless species copies another poisonous species.

(vii) Camouflage - Colours and shapes help animals blend in.

(a) Camel - Thick fur to stop the body from heating in the Sun.

(b) It has a large body to produce heat, but it has a relatively small surface from which to lose heat. The body can keep warmer than smaller animals could.

3. (a) They have good sight, run very fast, they are well camouflaged near. ~~this bet.~~

(b) Have strong teeth, and claws to tear the meat of a prey.

4. They are edible and taste bad, and they are avoided by birds.

Corrections

23.02.2018

2. (a) Feet that are very wide so they don't easily sink into soft sand. (Camel)

(b) The fur is white which makes it difficult to see. (Polar bear)

Activity 15

26 February 2018

Explain the following terms:

20.

- 1. Biodiversity - Total variety of species in an area. ✓
- 2. Monocultures - Single crop species planted over large areas. ✓
- 3. Exotic species - Species that are not indigenous to a specific area. ✓
- 4. Conservation - Wise management and use of natural resources that protects habits and wildlife. ✓
- 5. Sustainable - Using resources wisely so that they are not depleted. ✓

10
0

[10]

Activity 16

27.02.2018

Questions

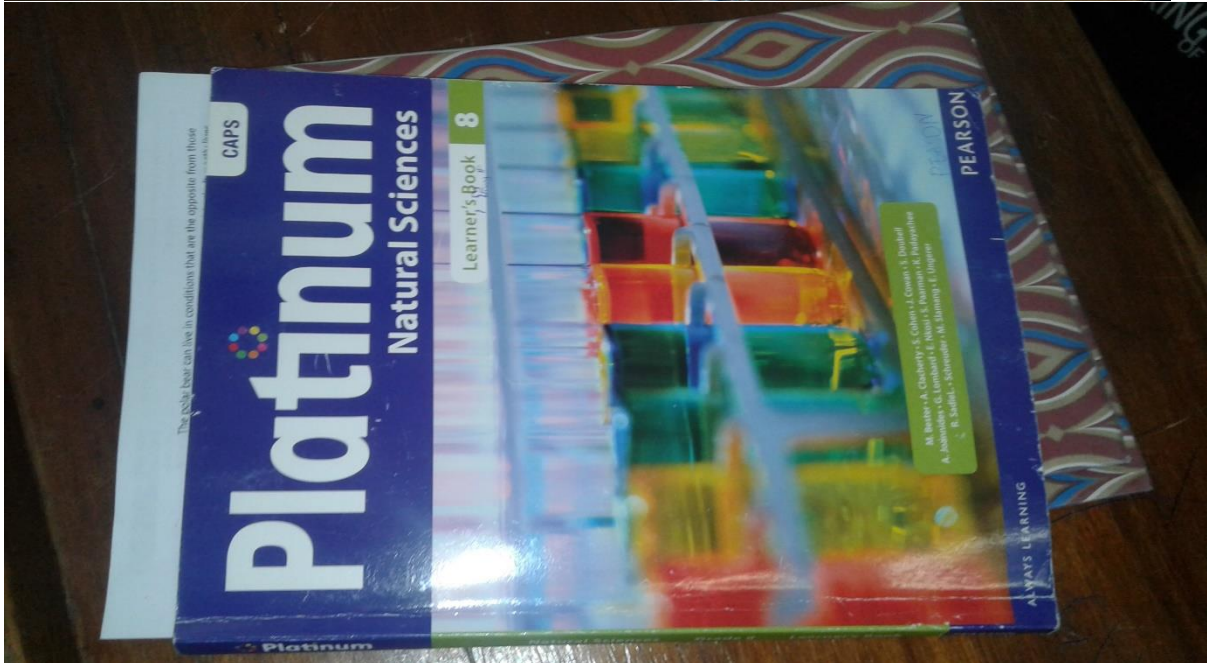
- 1) List 3 factors which describes biodiversity (3)
- 2) State 2 reasons why we conserve species. (2)
- 3) State 2 ways of controlling biodiversity. (2)

Answers

[7]

- 1) Pollution ✓
- 2) Use of pesticides ✓
- 3) Replanting natural habitats. ✓

APPENDIX C2: TEACHING AND LEARNING MATERIALS USED IN CLASSROOM



DATE: 22 FEBRUARY 2018

TOPIC: ADAPTATION

DURATION: 35 MINUTES

T1: Let's recap the last lesson. We talked about balance in the ecosystem, right? If there are animals in the ecosystem which are not getting the food - remember the whole pyramid - it is going to be disturbed. Primary consumers occupy the second trophic level. If the grass or plants die it means the second trophic level won't get energy from the producers, right? And in failing to get energy what is going to happen?

L: They are going to die

T1: So natural factors like fires, droughts, change the environment. Give me human factors

L: Illegal hunting

T1: yes – illegal hunting which is poaching. Another factor?

L: Pollution.

T1: Pollution, right good people?

L: Yes.

T1: Toxic gases will be in the atmosphere causing damage to everything. The last one?

L: Illegal removal of animals from their habitat

T1: excellent! Illegal removal of animals and plants from one place to another.

T1: Today let us address adaptation. What is adaptation? Adaptation good people when we summarise we can say these are characteristics that help a living thing to survive in its environment. Any characteristics that has changed to make an organism to suit its place it is referred to as adaptation. Let us unpack the English used here. I want to talk about different adaptations. You are in Grade 8 right? Do you know Africa, the top of Africa? You must be doing this in SS. People who stay up there, how are they in colour?

L: They are very dark

T1: Why are they dark?

L: It's because the temperatures are too strong

T1: Good. Clap hands for him. It's because the temperatures are very very high, and the sun is too hot. So their skin adapt to the environment they are in. Same as people in Holland – the eskimos. Those people are white, but when you compare their skin with white people from South Africa, their skin is too pale. So people from Holland have adapted to their environment. You know why they are like that? It's because of the temperatures which are very very low. If you go there you won't survive, you will need to develop those adaptations. People who will survive in those temperatures are those with lot of fats in their bodies because of the adipose tissues they can retain heat. Is it true that slender people get more cold than fat people in winter?

L: Yes.

T1: You will learn more about that in higher grades in Life Sciences. Back to business. You will get notes on this okay. Another example of adaptation we can look at the mouths of the birds. What do we call their mouth?

L: Beak.

T1: Very good. Birds have different beaks, why? They have different beaks according to what they eat, according to their mode of nutrition. You have to know the different types of birds, especially birds. We have eagles, vultures

L: learners giving different names of birds in their home language

T1: Let's take two examples of common birds. Let's take a chicken because we are familiar with it. When you look at its beak it is adapted to pick up mielies, right? Have you also see vultures or eagles? If not, you can look in your textbooks there are pictures. The mouth is very sharp. Why is it like that? It is because it doesn't eat mielies, but it eats meat. The beak is strong so that it can tear raw meat. Even plants have some adaptations. They need water. Why do they need water? For photosynthesis process. So they have the leaves. Broader leaves helps the plants retain more water. A plant will roll its leaves at the edges, so that it retains water. What do we call that process? You have to know it from Grade 5, 6 & 7. It is called transpiration. Transpiration rate will be less when the leaves are folded like that.

I am going to give you notes to look at how other animals are adapted to their environments ([teacher handing out printed notes to learners](#)). At the top I want you to highlight important points. There is the definition for adaptation. Highlight it. You must be able to explain that definition in a classwork or test. We have two examples of animals which are adapted to their environments. Let's look at paragraph 1 and 2. We have two examples of animals which live in extreme conditions. Underline the words extreme conditions. When we speak of extreme temperatures, it's either they are very hot or very cold. So we have the camel as the first example. The second example is the polar bear. Before we can read the notes, where does the camel live?

L: In the desert.

T1: And can we explain how is the desert?

L: There is a lot of sand.

T1: The other one?

L: It is a dryland

T1: Good. It means that the water is scarce. And the plants and animals living in the desert must adapt to the dry area. So let's look at the adaptations that the camel has structurally. Underline structurally. It has the nostrils that can be closed tight to keep the sand out. The eyes have big long eyelashes to protect them from being scratched by sand. Do not lose focus, we are still looking at how camels are adapted to live in a desert. The feet of the camel are very wide. Why? So that they cannot sink into the soft sand. Look at the picture, can you see the feet? Lastly, they have a thick fur. Why? To stop the body from heating in the sun. We have studied four of the camel's adaptation.

Adaptations can be divided into three: the structural, the functional and the behavioural. We are going to do the functional. The stomach of the camel can swell. Underline swell and put in brackets the word (big). Why? To make sure that it stores a lot of water. You must be able to give a factor or an adaptation and explain it. Give a reason why it is like that. Again it has a fatty hump. The fatty

hump is there to store food and at a later stage the food which has been stored can be changed into water when there is no water. The air passage of the camel is lined with mucus. Do you know what is mucus?

L: No

T1: [The teacher explained it in home language]. To make sure that the whole passage is wet. That is an adaptation to protect the lungs from drying out; because the air is very dry but the mucus makes it wet. Lastly, the behavioural adaptations. Camels rarely drink water. When they drink water they make sure they drink large amounts of water, which is stored in the stomach. Remember the stomach swells. So it enables the camel to go several days without drinking water. That is an adaptation.

Now let's look at the second animal, the bear on the next page. Look at the figure. Polar bears are well adapted to cold arctic conditions; they live in very cold areas. They have a very big fur to protect it from cold. It has a very large body to produce heat. It has small ears and a little a little tail to keep the heat in its body. They also have a very thick, double layered coat. To make sure that the body is insulated. Let us look at the functional adaptation of this bear. The legs of the polar bear have a special arrangement of blood vessels. It can store large amounts of fat under its skin. This is helping to make it buoyant in the water, insulate it from the cold and gives it's a supply of energy for the time when food is difficult to catch. Lastly the behavioural adaptation of the polar bear. Tell me, where does the polar bear live?

L: In ice.

[BELL RINGS, AND THE LESSON IS OVER]

DATE: 27 FEBRUARY 2018**TOPIC: CONSERVATION OF ECOSYSTEMS****DURATION: 35 MINUTES****The class started off by marking the previous classwork. It was defining of the following terms:****Biodiversity; monoculture; alien species; conservation; sustainable use.**

T1: We are done, now we are going to learn about conservation. We have talked about adaptations; now today let us talk about how we can conserve the ecosystem. How can we make sure that we don't deplete things that are in the ecosystem? If the ecosystem loses some of the species, especially at a higher rate in a great number at the end of the day, if we don't conserve. Let me give an example of natural plants or wildlife (springboks and impalas). If we don't make sure that we look after those animals, if we kill them and don't give them the chance to reproduce to have offsprings; will we have them in future? No, they will be finished. And then we will say they are extinct. We no longer have this plant because of overharvesting. Maybe we needed the plant for flu, without realising that we are not giving the plant enough chance to reproduce, to have some seed so that in future the coming generation can use it too. So it is very very important that we conserve things that are there in the ecosystem. It says when an ecosystem loses its biodiversity or species; its biodiversity will decrease if we don't conserve. Let me give you an example. In our days, we used to harvest rooibos, it has many benefits. It is medicinal. But if we overharvest it, it gets finished. And we can say the biodiversity decreases. Even with animals can go extinct and we have what happened with the Dodo bird. Do you still remember it, the bird that went extinct?

We have factors that decreases biodiversity, but before we go into that I want you to tell me what you think those factors are. Number 1, overharvesting of plants and animals. Do you know what the word overharvesting mean? The poor plants will go off from the ecosystem. [She tried to explained conservation in home language]. The second factor is pollution. How does pollution decrease biodiversity? Let's look at the figure on the book on page 44. The smoke released pollutes the atmosphere with harmful gases, which will cause damage to animals. Plants will also be affected by the smoke. You will learn this when you are in Grade 12. Over years the trees will develop a thick bark which is caused by the smoke. The other factor which decreases biodiversity is what? **Learners are silent.** The use of pesticides. What are pesticides if I may ask? **Learners silent.** Mam Thomas can you explain it to them?

R: Pesticides are chemicals used to kills pests or insects that eat plants.

T1: They will spray them over plants to kill those pests. The chemical will not kill the plants, but only the pests. And again, replacing natural habitats is a factor that decreases biodiversity. **Teacher writes notes on the chalkboard and gives learners two minutes to write.** You should write those factors in your book.

Let's look at how we control biodiversity. We have the biological control, the chemical control or the mechanical control. Let's look at the biological control; here they use living things to control the pests. For examples, if there are a lot of weeds, we can introduce locust so that they can eat the weeds. We control a particular population but introducing something that feeds on it. We don't use chemical. But we can also use chemicals to control like pesticides. Let's give an example; at home when you have cockroaches' problems what do you use?

L: Doom.

T1: Using it will kill the cockroaches. So doom is a chemical. Then we have mechanical control, we don't use any chemicals. For example when you have planted flowers and there are weeds growing there. What you can do as to remove those weeds by hands; or cutting down the alien plants. That is mechanical control. I will give you two minutes to write notes and we will have a classwork activity. [Learners wrote a classwork.](#)

DATE: 23 FEBRUARY 2018

TOPIC: BALANCE IN THE ECOSYSTEM

DURATION: 30 MINUTES

T2: Today we are on the topic of balance in the ecosystem. We previously defined what an ecosystem is right? And we know that the ecosystem consists of living and non-living things. Give me examples of living things.

L: Organisms, people, animals, plants.

T2: And examples of non-living things;

L: resources, food, light, habitat and temperature

T2: Every ecosystem for example, let's say this school is an ecosystem, we have the soil, water, and there are classrooms, light, heat. Each and every ecosystem has a certain number of organisms it can carry. That is what we call the carrying capacity. Carrying capacity is the maximum number of individuals in an environment that the environment can afford. If our school have water and resources, and teachers, it should be enough for every individual in the school, right. So we speak of the environment, it means only a certain number of organisms can be here and have enough resources provided for them. So look here, if we have resources on this side, and an organism on the other side, what we want is to have a balance between the two. We rather have more resources than there are organisms, not the other way round. Just like a see-saw, when the other one side is high the other one is low. If it happens that we have a limited number of resources, then there is going to be a disruption or an imbalance in the environment. If we have more organisms than there are resources, then there is a problem in the ecosystem. Let's make an example. We have grasses here and rabbits. The grass is the resource, and it is enough for our rabbits. But if the population of rabbits is increasing but the grass is not increasing, there is an imbalance. The resource is limited. Eventually what will happen to the rabbits as the grass is decreasing? They will die of hunger because the grass is not enough to feed all of them. Then when the number of rabbits decreases, there will be balance again.

Now let's look at natural factors that disrupt the ecosystem. Diseases. If a population of certain species is attacked by a certain disease the population will decrease and there will be an imbalance in the ecosystem. Drought is another factor. Right now in Cape Town there is drought because of the water crisis. Other factors are veld fires, floods, tsunamis or earthquakes.

Now I am going to give you a speed test. [The teacher asked questions orally while learners were writing in their books.](#)

1. What do we mean by carrying capacity?
2. Describe how an ecosystem can be destroyed or disrupted?
3. List three natural factors that can destroy the ecosystem.
4. Use one of the factors mentioned above to explain how the balance in the ecosystem is disrupted.

DATE: 27 FEBRUARY 2018

TOPIC: CONSERVATION OF ECOSYSTEMS

DURATION: 35 MINUTES

T2: Morning morning my babies.

L: Morning Ma'am.

T2: Did you bring your textbooks?

L: Yes.

T2: Take them out. Today we are doing the topic of conservation of ecosystems, okay. Before we start, I am going to give you some important definitions that you must learn. Write them down in your notebooks. [Teacher writes on the chalkboard]. First one, conservation. Second one, extinction. Alien species, and the last one is biodiversity.

By now all of you should know what an ecosystem is, right?

L: Yes ma'am.

T2: Good. So when we talk about conserving ecosystems, what it basically means is saving the ecosystems. We do not want to lose the plants and animals that we have, so we conserve them. Does anyone know how do we conserve animals? How do we keep them safe?

L: The animals are kept in the zoos.

T2: Good. And where else? Anyone? Have you ever heard of a place called a game reserve?

L: Yes.

T2: Which ones do you know?

L: Mafikeng game reserve

T2: Good. So such places are meant to conserve animals and plants. But it is not the responsibility of people in the zoos or game reserves to conserve animals, we must also do the same. Even if it is not the animals. For example, here at school, we can practice how to conserve water. We must make sure that water is not wasted, otherwise we won't have any water left. So water also need to be conserved. Other ways of conserving the ecosystem can be through recycling. Keeping the environment clean.

On the definition list there is a term "alien species". What are aliens? What do you know about aliens?

L: I have only seen aliens in movies (laughs)

T2: And what are they?

L: They are things that come from space.

T2: So aliens are not from our planet, right? They come from space. The same with alien species; they are plants that are not naturally occurring in a certain place. They come from another place and grow in another. And they are horrible because they use too much water. Another important thing is that we must learn how to use our natural resources carefully, without wasting. If we don't, the

natural resources become extinct. Check the definition of extinction. It means something is no longer found on planet earth. For example, if all rhinos die and we don't have them anymore on Earth, we say that they are extinct. Do you understand?

L: Yes ma'am.

T2: Okay, so for your homework, I want you to go and do a mini research about the importance of maintaining biodiversity. You can look at other textbooks, or google the information.

L: Ma'am, do we do it in groups?

T2: No. Everyone for himself. I want to see if you can do it alone. It's not a project, it's just a homework, but we are going to mark it. So make sure you write.

APPENDIX E: PSF AGENDA



Education and Sport Development

Department of Education and Sport Development
Departement van Onderwys en Sportontwikkeling
Lefapha la Thuto le Tlhabololo ya Metshameko

NORTH WEST PROVINCE

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Mmabatho 27.
Tel: (018) 388 – 171
e-mail: @nwpg.gov.

Date: 28 February 2018

1. Opening and welcome
2. Signing of attendance register
3. Realignment of sub-districts
4. Review of 2017 NWPA results
5. Subject performance (per school)
6. Schools subject improvement plans
7. 2018 targets
8. Overview of policy imperatives
 - 8.1. Natural Sciences CAPS documents (Grade 7 – 9)
 - 8.2. NPPPR
 - 8.3. NPA
9. File requirements (teachers and learners files)
10. POA for 2018 (Grade 8 & 9)
11. Term 1 pace-setter: Grade 8
12. Term 1 pace-setter: Grade 9
13. Practical tasks for Grade 8 and 9
 - 13.1. Grade 8 content: Life and Living – interactions and interdependence within the environment / Microorganisms
 - 13.2. Grade 9 content: Life and Living – Systems in the human body/ Cells as the basic units of life
14. Announcements
15. Closure



“Towards Excellence in Education and Sport Development”

APPENDIX F: PROFESSIONAL SUPPORT FORUM OBSERVATION SCHEDULE

1. The teachers	
Number of teachers	
Level of participation	
Nature of participation (as individuals)	
Nature of participation (as a group)	
Enablers	
Constraints	
Other	
2. The subject advisor	
Approach	
Role	
Activities given to / or done with teachers	
other	
3. Resources	
Resources used	
How are the resources used?	
Are the resources used effectively or not?	
4. Setup / arrangements	
Arrangement of the venue (spacious, conducive environment etc.)	
Time management	
Other	

APPENDIX G: PSF OBSERVATION NOTES

PSF OBSERVATION (LETSATSIANG Science Hq)

Time: 13:45 28/02/18

- ⇒ D21 teachers when the session starts.
- ⇒ Subject (SA) advisor starts with some motivational quotes on powerpoint.
- ⇒ Attendance register is circulated, teachers sign.
- ⇒ SA goes through the agenda.
- ⇒ 1st item: SA explains the restructuring of sub-districts. She welcomes new schools to Mahikang sub-districts.
- ⇒ SA gives a review of 2017 end of year Ns exams (per school) + Powerpoint presentation.
- ⇒ Presents schools subject improvement plans.
- ⇒ Continues powerpoint presentation on 2018 subject targets.
- ⇒ She asks teachers to take out their Ns CAPS documents for item 8.1 on the agenda (only a few teachers brought copies)
- ⇒ She reads aims and principles.
- ⇒ Reads through and explains section 2 of the document (teachers are just listening)
- ⇒ Reads through section 3: focuses only on Gr 8 & 9 (section of content and concepts). {no discussions of content, just reading through the document}
- ⇒ Asks teachers how far they are with the ATP, only few teachers responds.
- { some are a week behind, some are on track }

Duration of POF [13:45 - 16:00] 2hrs 15 minutes

⇒ SA hands out POA for 2018. Explains what assessments are required for each term.

⇒ Explains pace-setters for Gr 8 and 9.
⇒ Hands out file index copies (teachers & learners)

*** Other teachers are leaving. They have to catch buses [teachers who are new in the sub-district - they stay for form here]

⇒ Teachers asked to form groups according to same grades (8 & 9)

⇒ Each group is given a practical task to work on (for term 1 practical assessment).
[enjoyed working together]

⇒ Teachers discussing the tasks in their groups.

⇒ One group asks for a CAPS document to look at skills to be assessed in practical task

*** ⇒ DSA is going around tables to check the groups, and offer help.

⇒ Most groups didn't complete the tasks.

Subject adviser scolded the group presentations she was one. She asks group leaders to check her the tasks.

⇒ She made a few announcements, and closed the session. [session ended at 16:00]

RESOURCES

* ATP, POA and file materials

* NSCAPS document

* No other resources used or handed out.

CLASSROOM SETTING

* No displays on walls

* Seating arrangements in pairs (Desks facing front)

* Classroom small. Not enough space

* No. of teachers: 35

APPENDIX H: POST-LESSON OBSERVATION INTERVIEW SCHEDULE

1. For how many years have you been teaching?
2. And for long have you been teaching NS, and in which grades?
3. For how long have you been part of this PSF?
4. What roles do you, as teachers, play in the PSF?
5. What is the role of the subject advisor?
6. Besides the Subject advisor, who else facilitates the sessions?
7. Do you feel that PSFs are a good space for your professional development as a Natural Sciences teacher? Please elaborate.
8. What activities take place in the NS PSF, and how, if in any way, do they benefit you?
9. What expectations do you have towards NS PSF session? Are they always met?
10. What would you say are factors that constrain your professional development in the PSF?
11. What is your ideal PSF? How do you want the PSF to be structured in order to benefit you and make you an effective NS teacher?
12. What motivates you to keep attending PSF meetings?

KT: Okay it's recording now. So let's start with your experience. How many years have you been teaching?

T1: yooh! It's more than 20 years. 23 years to be specific

KT: And for long have you been teaching NS?

T1: I started last year. So it's two years.

KT: Did you attend any CAPS training?

T1: For NS no. But when CAPS was introduced I attended a workshop for Life Sciences.

KT: Did you find the training helpful or not? And why?

T1: it was helpful because we were informed of some new topics that were introduced, especially on topics of the environmental studies. But they did not go deep into details.

KT: In grade NS which topics do you enjoy teaching most?

T1: mmm. I love teaching the Life and Living topics in term one; Ecology, photosynthesis, food chains, ecosystems ... you see those ones.

KT: Yes. And why if I may ask?

T1: Maybe it's because I am a Life Science person. It's part of what I teach in Life Sciences. So it's my speciality.

KT: And which topics do you find challenging to teach?

T1: You know that Natural Sciences is divided into four strands right? And me I majored in Biology and chemistry, which fall under Life and Living, and Matter and Materials. These ones are easy for me to teach. The one that I find difficult or challenging to teach are Physics and Geo (Geography).

KT: So can we look back at the two lessons I observed. The first one you were teaching about adaptation. You seemed like you were enjoying teaching that topic?

T1: Yes. I did enjoy it.

KT: Why?

T1: I was prepared for the lesson. And that's one of the topics I like because they are similar to what I what I teach in life sciences.

KT: I see. And tell me, how do you decide on the teaching methods you are going to use for each lesson, and the material you will need?

T1: I mean this is not something you think too much about. It comes with experience. When I do my lesson preparations, I can see whether I am going to need to perform an experiment or not. If so, I prepare all the apparatus I will use in class, do the experiment alone first to see if it works, then perform it with learners in class. So you plan as you go.

KT: From the lesson observation I did with you, I noticed that you were using only textbooks and printed notes, and writing on the chalkboard here and there. Do you do like that always?

T1: Nooo! It's just I did not have enough time to prepare thoroughly. I sometimes use a laptop. I use a projector, but I need to take learners to the hall because in the classroom there is too much light. I teach NS with two other teachers in Grade 8, and I must say it is good to work with young teachers in school because they understand these things of technology. I am a BBT – born before technology, so I never used a computer before when I teach. But since they came they are teaching me to make powerpoint lessons. But most of the time I ask them to connect for me before I start my lesson (laughs). I am still learning you know.

KT: For topics with environmental content, what methods do you use? And why?

T1: I start by introducing the topic first then ask learners questions. And most of the times questions lead to discussions. I make sure that I engage my learners and test their knowledge of the topic. During discussions I am able to see their understanding. They can also learn from each other.

KT: Do you ever do outdoor lesson?

T1: No. Our school yard doesn't have anything that can be used for NS lessons.

KT: Do you have any activities in the school, like extra-mural activities that are related to environmental education?

T1: Not really. But we encourage learners to recycle. And we also we have a group of learners who do environmental campaigns. They talk about things like pollution, waste, planting trees and so on.

KT: What challenges do you face in teaching environmental content topics?

T1: Eish. Our learners don't really show that they understand when you teach them. So sometimes it's difficult for me to teach in a way that is easy for them. Like I know what to teach but delivering it to these kids... you ask them things like "what is conservation?" it sound like something they have never heard before. You need to explain in Setswana for them to understand.

KT: If you were to get assistance with environmental topics, which ones would it be? And in what way?

T1: I think the topics of adaptations and Conservation of the ecosystem. I think you realised when I was teaching that, on the second lesson you observed, I was not as confident as when I was teaching the first one. The learners were also not participating that much. I would love to have get help with teaching materials that are interactive like videos, for learners to see how different animals adapt to the environment.

KT: And what about the topic of conservation of the ecosystem?

T1: For that topic, I enjoy teaching it but I want to get learners to be able to relate to it. I wish I could get help and take them to Mafikeng Game reserve so that they can see what conservation means and learn more.

KT: What would you say are constraining factors for you in teaching environmental content?

T1: Learners' interest. Our learners don't show any interest in their studies. Not only for environmental content topics, any topic. Another thing is lack of enough resources. I need charts, videos. Maybe also the fact that I have not being teaching the subject for long. I still need to get better understanding of some topics, and teach them better.

KT: From the school what kind of support do you receive?

T1: It is not specifically for how I teach. It is for monitoring learners' progress. We hold meetings to discuss general matters relating to curriculum – like how far we are with the ATP [Annual Teaching Plan], assessment and pass rates. This is done by the SMT [school management team].

KT: Do you receive any support from the Department? Please elaborate.

T1: Not the way I wish they could. We only get support through workshops.

KT: and what do you wish the Department could do?

T1: The subject advisor should come to our school to see our situations, and provide us with everything that we need, like resources for teaching. The department should also take us to different workshops to learn how to teach different topics in NS.

KT: In terms of your professional development, what support do you receive or what activities do you participate in?

T1: The Department offers us PSF workshops for professional development. That is the only activity I participate in.

KT: Do you think that PSFs only are enough for your professional development as a Natural Sciences teacher?

T1: Obviously not. But I don't know of any professional development programmes around. If there was any I would join.

KT: How long have you been part of the NS PSF?

T1: For two years

KT: Does the PSF meet your expectations?

T1: At other times. It's not all the times, it just depends on what we do on that particular meeting.

KT: Can you please elaborate

T1: Most of the PSF meetings the subject advisor focuses on things like admin, checking files, looking at school performances in NS. We will spend the whole time talking about that. So on those days I don't find the PSF meeting my expectations. Because when I go I expect discussions.

KT: What would you say are factors that constrain your professional development in the PSF?

T1: Umm. Less time of meetings. Two hours once in a term is not enough at all. Number two, the fact that there are less discussions between us teachers in the PSF. Most times the subject advisor is the one who keeps talking to us. Ooh and one more thing is not having or let

me say, not given the platform to say what is it that we want to discuss in the PSFs. I mean, how will the Department develop me if they don't even know what is it that I am struggling with. So yes, those are the factors.

KT: What is your ideal PSF? What do you want the PSF to be like in order to support your professional development?

T1: I want a lot of things. First of all I want PSF meetings to be more than one per term. It is not enough for us to meet only once. They can even consider organising PSFs during school holidays. And secondly I want us to be able to discuss content. I know as teachers we struggle with some topics, but we don't get a chance to talk about these issues. We must be given a chance to interact with each on subject content of what we know are difficult topics for us. Lastly, I want to receive extra teaching materials from every meeting.

KT: What motivates you to keep attending PSF meetings?

T1: I will say it's my passion for the subject. I keep going hoping that one day it will improve.

APPENDIX J: POST LESSON OBSERVATION FOLLOW-UP INTERVIEW WITH
TEACHER 2 [PLOIT2]

KT: For how many years have you been teaching?

T2: it's only a year. I started last year.

KT: And for long have you been NS?

T2: In which grades?

KT: All grades, and Grade 8 specifically

T2: I only started teaching last year, and I was given Grade 7 NS and chemistry in Grade 10. Then this year I was allocated Grade 8 NS. So in both grades it has been a few months. Like 9 months or so.

KT: Which other subjects do you teach?

The beginning of this year my allocation was changed. I was moved to Grade 8 NS, Life Sciences Grade 10 and Technology Grade 8. Now I had to struggle again to teach NS in Grade 8.

KT: Have you attended any CAPS training?

T2: No. Never heard of such training. I have been attending PSFs only.

KT: Okay. So tell me, in Grade 8 NS which topics do you enjoy teaching most?

T2: I am a Life Sciences major, and have a bit of chemistry from my qualification. I therefore enjoy teaching topics related to that.

KT: And what about environmental topics?

T2: In Life Sciences we do have such topics. But they are not my speciality. I specialised in Biomedical Sciences. So I have to read more and learn some of the concepts in those environmental topics. I do the same even in Grade 10. But I honestly cannot say I enjoy them. I love human biology more.

KT: And which topics do you find challenging to teach?

T2: of course the topics we have been talking about, environmental topics and some parts of physics. I don't take chances with those ones. I make sure I am thoroughly prepared when I go to class.

KT: can we look back at the two lessons I observed. The first one you were teaching about balance in the ecosystem. How confident were you when teaching that?

T2: it was not a difficult topic. I could use examples that learners could relate to. For example, when I spoke to them about carrying capacity, I made an example of the school yard and spoke about the number of learners the school can accommodate, and asked them what would happen if we had double the number of learners. The first they thought of was shortage of food, and some mentioned shortage of books. So they could understand the concept. I was confident because I had prepared.

KT: Now let us talk about your teaching approach. How do you decide on the teaching methods you are going to use for each lesson, and the materials you will need?

T2: Since I am still new in teaching, I rely on the CAPS work schedule. It kinda guides one on how to teach each topic. There are suggested activities and practicals or demonstrations. So I go through it when I do lesson preps. At times we don't have all the resources at school but I improvise. But personally, I prefer teaching and asking questions every now and then to see if they understand.

KT: In the last lesson I observed you did an oral speed test. Why?

T2: Well, I have come to realise that some of my learners have an understanding of the concepts but writing it down, like when you give them a classwork with questions written on the chalkboard, they don't understand. So when I ask them questions orally they seem perform better. This is just informal assessment. I do however give them proper classwork or class tests.

KT: Can you quickly tell me about shortage of resources.

T2: The number one challenge is textbooks. I think you saw that my learners had to share textbooks, right? But the truth is we do get textbooks, but what I realised is that our school's retrieving system is not in place. Last year we received new books, and they were enough for all learners. But in December they didn't all return the books. We struggle to get them back. So now they have to share, some are even sharing the books in threes.

KT: For topics with environmental content, what methods do you use? And why?

T2: I start by introducing the topic first then ask learners questions. And most of the times questions lead to discussions. I make sure that I engage my learners and test their knowledge of the topic. During discussions I am able to see their understanding. They can also learn from each other.

KT: Do you ever do outdoor lesson?

T2: I have never done that. I mean, there is nothing around the school yard that I can use for demonstrations or experiments in my lessons. It's very dry.

KT: Do you have any activities in the school, like extra-mural activities that are related to environmental education?

T2: Not that I know of. Ever since I have been here I have not seen anything of that nature.

KT: What challenges do you face in teaching environmental content topics?

T2: So many challenges. Besides the content itself, there are general challenges. I know the content because I majored in Life Science, but teaching it is not easy. I just wish they will not move me from Grade 8. Again next year because it would help me to master the content and gain confidence in teaching NS in Grade 8. Other challenges, firstly, the issue of overcrowded classrooms. Can you believe it that in all the classes I teach, each class has approximately 60 kids? That is a problem on its own. Then we have shortage of textbooks, like I indicated. Then again, there is no enough furnisher. Learners are sharing desks some in threes and fours. Already it creates an uncondusive environment for teaching and learning.

The challenge that I have in teaching environment topics is the topic of adaptation, and the concept of extinction. I think language always plays a role. It is a problem for me when I have to explain to them in terms that they can understand.

KT: If you were to get assistance with environmental topics, which ones would it be? And in what way?

T2: The ones I have indicated. And I also think that in Grade 7 Biodiversity is also a challenge to teach. When leaners move to Grade 8 they are still lacking in some basics which they should have learned from Grade 7.

KT: What would you say are constraining factors for you in teaching environmental content?

T2: I feel like I have already answered that. But let me say the constraining factors are the following: language barrier; lack of basics from lower grades – especially Grade 7; lack of textbooks; overcrowded classrooms; and we do not have a friendly school surrounding for outdoor lessons. But also the learners themselves do not show interest in their studies. You need to push them every time.

KT: From the school what kind of support do you receive?

T2: The school is trying but it's not good enough. They buy textbooks for us, but come end of the year, there is no proper retrieval. Then we keep having the same issue of shortage of books. We do hold Science Department meetings where we discuss some of the things we are struggling with. I also work together with other science teachers in the school.

KT: Do you receive any support from the Department? Please elaborate.

T2: yes we do. They offer workshops where we learn different things.

KT: and what do you wish the Department could do?

T2: Maybe if they made it possible for us to register for short courses like Nature Conservation, so that we increase our knowledge in those topics. Or they could also help us affiliate with certain programmes that can help us develop us in our teaching and get more knowledge.

KT: In terms of your professional development, what support do you receive or what activities do you participate in?

T2: I attend PSFs. And then I have been part of the Science Expo Competitions. I have attended a workshop to be a judge, and it was a very great opportunity. It helped me to also look at how I can make science interesting to my learners through projects and research.

KT: Do you think that PSFs only are enough for your professional development as a Natural Sciences teacher?

T2: I want more. Besides the Science Expo, I wish there were other forums or science clubs where we engage as science teachers.

KT: How long have you been part of the NS PSF?

T2: only a few months because I started not so long ago to teach.

KT: Does the PSF meet your expectations?

T2: yes and no. yes because the administration part of teaching is very useful for me as a new teacher in the field. I received materials for the file and got to understand what is expected of me. And no because as much as administration is good, I expected that we will learn better ways of teaching different concepts, but that is not happening.

KT: What would you say are factors that constrain your professional development in the PSF?

T2: The fact that we don't engage in deep discussions concerning NS content. We spend a lot of time talking subject administration, which is nonetheless equally important. So that's my first one, not breaking down content. Number two, PSFs are held during school hours which means as teachers we lose our contact time with learners. After attending the PSF there is no time allocated for that missed teaching time, and I as a teacher am expected to see how make up for it.

KT: What is your ideal PSF? What do you want the PSF to be like in order to support your professional development?

T2: I want content discussions, and learning new, better methods for teaching. I wish we could have workshops that with administration only and the ones that deal with content. I also want to be supplied with teaching materials. Use previous question papers that have been written for our discussions, and see where we can improve the teaching, even the planning, of our subject.

KT: What motivates you to keep attending PSF meetings?

T2: I want to grow as a teacher. I have a constant desire to always do better and improve in teaching NS. I also want to see my kids having a better understanding of the subject and passing. I want better results for my learners at the end of the year.

KT: For how many years have you been teaching?

T3: it's more than 30 years

KT: How long have you been teaching NS, and in which grades?

T3: 18 years. I have taught Grade 7 to 9. But currently I am teaching Grade 8 and 9 only.

KT: What are your qualifications?

T3: I studied a for Diploma in Higher Education

KT: Why did you choose to teach NS?

KT: Regarding teaching environmental topics in NS, what would enable you to teach it effectively?

T3: I want small numbers of learners in my class so that I can do outdoor lessons. Again I need more teaching and learning resources, and also how to bring back learners' interest in NS.

T3: I have always wanted to teach science. It is part of my subject knowledge

KT: For how long have you been part of the NS PSF?

T3: I can't tell you the exact number of years but it's been a very long time.

KT: What roles do you, as teachers, play in the PSF?

T3: No role whatsoever, except when we have group activities.

KT: What is the role of the subject advisor?

T3: She does everything, and all the talking.

KT: Besides the Subject advisor, who else facilitates the sessions?

T3: Most of the times it's here facilitating. We never really get other facilitators. It's on rare occasions when we have certain organisations coming to deal with specific topics.

KT: Do you feel that PSFs are a good space for your professional development as a Natural Sciences teacher? Please elaborate.

T3: Not anymore. The meetings are mainly aimed at empowering beginner teachers. They are now becoming less and less relevant for us experienced teachers.

KT: Do you maybe want to elaborate on what you mean when you say they are becoming less relevant for you experienced teachers?

T3: The focus is centred on admin. For someone who has 18 years' experience in teaching NS, admin is something I have mastered. There needs to be a balance between activities done in the PSF to accommodate everyone, and to ensure that we all have our professional development needs met.

KT: What activities take place in the NS PSF, and how, if in any way, do they benefit you?

T3: about 80% of the time is spent on admin issues. I don't benefit from that unless there are new requirements. The rest we have group discussions and practical tasks.

KT: What expectations do you have towards NS PSF session? Are they always met?

T3: I no longer have any expectations because we have the same routine every session.

KT: What would you say are factors that constrain your professional development in the PSF?

T3: The imbalance in the activities that are done in the PSF. I do not gain anything from them.

KT: What is your ideal PSF? How do you want the PSF to be structured in order to benefit you and make you an effective NS teacher?

T3: I want sessions where we concentrate and elaborate on classroom activities that we can give to learners. I also want teaching materials like past question papers and extra worksheets. Spend more time discussing subject content- that's what matters at the end of the day.

KT: what motivates you to keep attending PSF meetings?

T3: it is compulsory, so I have to attend.

APPENDIX L: SUBJECT ADVISOR INTERVIEW TRANSCRIPT [ISA]

KT: For how long has this NS PSF been running?

SA: 11years

KT: So does that mean you have been a subject advisor for 11 years?

SA: Yes

KT: How many schools are you working with in your sub-district?

SA: It's 152

KT: and what are your responsibilities as the subject advisor?

SA: It's monitoring and support, conducting PSFs, analysis of the results, accounting for performance, assisting teachers in lesson plan preparations, inducting newly appointed educators in terms of the policy imperatives, and from there schools visiting. Under school visiting we monitor the implementation of the curriculum, check the timetable, check analysis of the results, have to clarify why there is no performance if there is no performance, check the ATP coverage, whether the teacher is on par with what is expected, check the expected NCS policies, all three of them, and the school policies, and circular 36401. That's it. And communicate with the principal, the HOD's and the teacher. And if the teacher is behind he will give me the recovery plan, and the principal will tell you why there is no teacher, because sometimes you find that there is no appointed teacher for the subject. I think that is enough.

KT: Okay. Thank you. So in PSF meetings, what is your role?

SA: I am the facilitator in the meeting.

KT: And the role of the teachers?

SA: We are there to communicate about the subject generally. In term 1 we look at the policy imperatives, from there we go to the content and concepts to be taught in the subject. Depending on what type of PSF it is. If it is induction, I will induct them on policy imperatives. When it is subject content training, we are going to discuss the content. When it is time for practical, we perform practicals.

KT: And do you have any policies or guidelines that guide the PSF?

SA: yes. Basically you look at the expectations of the policy from teachers, and then you again, you check at what the province requires. Before I go to PSF I have to check with the province, on how far they are with planning of everything, like POAs.

KT: Do you maybe have copies of those?

SA: No.

KT: one other question is when you plan PSF sessions, do you sometimes consult the teachers to know what is it that they would love to discuss, especially when it is content PSFs?

SA: Yes. In most cases we get which topics give them problems. I am also informed by the analysis to see which topic is a problem at which school.

KT: Which topics are challenging to teachers in Grade 7 and 8?

SA: In Grade 7 variation is a problem. In Grade 8 it is the last two topics. You will check them for me. Planet Earth and Beyond. Planet Earth and Beyond is a nightmare to teach. Also the topics of Life and Living are a problem. Also topics of energy and changes. In Grade 7 periodic table is challenge. Because not all teachers have done science, so teaching the periodic table is a problem. Also the history of teaching the periodic table is a problem. In Grade 8 and 9, electrolysis is a problem. In Grade 8 the problem is Light. It is challenge.

KT: So this one of Biodiversity and environmental topics, like ecosystems and others, how have you as a subject prepared teachers to deal with any challenge they might have.

SA: During training, we sit down and discuss that topic. The topic of variation falls under Biodiversity. So we make it as a demonstration. I take teachers, and we do a demonstration on ear lobes, and we do graphs from that. We do it practically.

KT: So would you say the PSF is able to meet teachers' professional development needs?

SA: 100 %

KT: In what way if you may elaborate?

SA: During PSFs we discuss policy imperatives, we discuss practical activities that are to be assessed during that period. We are going to assess the content and concepts to taught during that period. Therefore I think it's 100 %.

KT: Okay. The last one...How do you ensure that the PSF meetings accommodate both new and experienced teachers?

SA: Initially, the first week I do induction to those who are teaching the subject for the very first time. From there, the following week now I take the entire group together, the old and the new teachers together.

APPENDIX M1: LESSON PLAN 1 OF TEACHER 1



Education and Sport Development

Department of Education and Sport Development
 Departement van Onderwys en Sportontwikkeling
 Lefapha la Thuto le Tlhabololo ya Metshameko

NORTH WEST PROVINCE

SUBJECT: Natural Sciences	DATE: 19 FEB. 2018	GRADE: 8	DURATION: 3hrs:30
TOPIC: Adaptations		SUB-TOPIC: Poaching,	
CONTENT: - Adaptation and extinction			
LESSON OBJECTIVES: After the lesson learners should be able to: Explain natural terms involved in this topic			
TEACHING METHODOLOGIES: Discussion, Question and answer			
TEACHER'S ACTIVITIES: - Explain terms involved, adaptation of plants and animals in extreme environments - Camouflage and mimicry			
LEARNERS' ACTIVITIES: answer questions asked by the teacher to show understanding - learn how plants and animals adapt to changing environmental conditions and adaptations.			
EXPANDED OPPORTUNITIES: do			
ASSESSMENT: Activity Pg 43: 91-3.			
RESOURCES: Platinum (NS)			
REFLECTION:			
HOD'S COMMENTS:			
HOD'S SIGNATURE:			

SECONDARY SCHOOL

LESSON PREPARATION PLAN

SCHOOL: [REDACTED]

SUBJECT: NATURAL SCIENCES

DATE: 19.02.2018 - 24.02.2018

TEACHER: [REDACTED]

GRADES: 8^{TT}

TIME (IN WEEKS):

TERM: 1 st	Grade: 8 ^{TT}	Balance in an ecosystem, Adaptation and conservation of the ecosystem.
Topic:	Interactions and interdependence within the environment	
SPECIFIC PRIORS (What do you know from previous grade?)	<p>learners are asked to identify what they see (biotic) in their ecosystem.</p> <p>Explain terms like Pollution, Poaching, deforestation, etc.</p>	
INQUIRY QUESTIONS (What do you want to know?)		
LEARNING OBJECTIVES (What do you want to achieve?)		
TEACHER ACTIVITIES	LEARNER ACTIVITIES	
Explain terminology involved	Learn new terms	

1

<p> <ul style="list-style-type: none"> - Explains Perceps describing the ecosystem. - Adaptations, survival, animals, plants & Resources: CIE & NC textbooks - Relevant pictures, charts </p> <p> Assessment: Activities in the Form homework and class-work. </p>	
<p> Assessment: </p>	<p> <ul style="list-style-type: none"> - Ask questions to get clarity, where they don't understand, - observe structures that make animals plants to adapt (suit) in an environment. Resources: Text books </p>



Education and Sport Development
 Department of Education and Sport Development
 Departement van Onderwys en Sportontwikkeling
 Lefapha la Thuto le Tihabololo ya Metshameko
NORTH WEST PROVINCE

SUBJECT: Natural Sciences	DATE: 23/FEB/19	GRADE: 8 T.L	DURATION: 1 day
TOPIC: Interdependence and Interactions within the environment		SUB-TOPIC: Balance in the ecosystem	
CONTENT: Learners should be able to explain: - Disruptions to the ecosystem; natural and human factors			
LESSON OBJECTIVES: - Define ecosystems; - Give examples of factors disruption the balance - Examples of human factors - Examples of natural factors			
TEACHING METHODOLOGIES: Discussions, questions and answers			
KNOWLEDGE: - Balance in the ecosystem - Some background knowledge from Gr 7		SKILLS: - Evaluating - Identifying different ecosystems - Reading and writing	
TEACHER'S ACTIVITIES: - Give notes - Ask learners questions - Explain concepts of balance in the ecosystem			
LEARNERS' ACTIVITIES: - Ask and answer questions - Write notes - Write classwork			
INCLUSIVITY:			
EXPANDED OPPORTUNITIES: Give extra activities from different textbooks			
ASSESSMENT: Classwork and homework			
RESOURCES: Ms textbook			
REFLECTION:			
HOD'S COMMENTS:			
HOD'S SIGNATURE:			

APPENDIX O: TEACHER PROFILING QUESTIONNAIRE

1. Name (optional) 2. Gender.....

SCHOOL PROFILE

2. Name of School
3. In which area is your school? (E.g. Urban, Rural, Township).....
4. How many teachers do you have in your school?
5. How many learners do you have in your school?
6. What is the language of instruction in your school?
7. What is the first language of the majority of the learners in your school?
8. Which grades are offered at your school?.....
9. What subjects are offered at your school?.....
10. Is your school Governing Body and principal supportive of the curriculum changes in the school? Elaborate.
.....
.....
11. Briefly describe the socio-economic context of your school.....
.....
12. What is the current status of environmental education at your school?
.....
.....
13. Do you have environmental education resources available at your school? List a few examples.....
.....
14. Do you have access to environmental education resources outside of your school? If so, list a few examples.....

Teacher and classroom profile

1. Years of teaching experience
2. For how many years have you taught Natural Sciences?
3. Which other subjects are you responsible for?
4. Which grades do you teach?

5. How many learners do you have in your class/ classes?
6. What are your qualifications?
7. Why are you teaching NS?
8. Briefly describe the main teaching methods and approaches that you use in NS?
9. What resources do you use in your teaching?
10. What challenges are you encountering in the teaching of NS?
11. What challenges do you encounter particularly in teaching the topic of “interaction and interdependence within the environment”?
12. What support is available to you, for example from the Department of Basic Education and other service providers?
.....
.....

APPENDIX P: TEACHERS' REFLECTION QUESTIONNAIRE (ABOUT PLCS AND TEACHERS' DEVELOPMENT)

1. Name (optional) Gender
2. Briefly describe what professional development support you receive or activities you participate in
3. What are some of the challenges you experience in professional development?
4. Despite the challenges, what would you say enables / makes it possible for you to participate in the professional development?
5. What role do you play in the professional development activities?
6. What do you understand by term PLC?
7. Are you part of any PLC? Please elaborate. (What is your role?)
8. For how long have you been part of this professional support forum (PSF)?
9. What activities take place in the PSF, and how do they benefit you if in any way they do?
10. If in any way, how do you think the PSF could be structured in such a way that it benefits you more?

REFLECTIONS

11. What were your expectations from this PSF session? Were they met? Please explain.
12. What did you benefit from this session?
13. If you were to attend another session which also focuses on environmental education what more professional development support would you still need? Please explain.
14. Any general comments or recommendations you would like to make regarding your own professional development and/ or the PSF?



RHODES UNIVERSITY

Grahamstown • 6140 • South Africa

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PROPOSAL AND ETHICAL CLEARANCE APPROVAL

Ethical clearance number 2017.7.04.04

The minute of the EHDC meeting of 5 October 2017 reflect the following:

**2017.7.04 CLASS B RESTRICTED MATTERS
MASTER OF EDUCATION RESEARCH PROPOSALS**

To consider the following research proposal for the degree of Master of Education in the Faculty of Education:

Kgomotso Emily Thomas (17T5788)

Topic: An exploration of how professional learning communities can contribute to development of teachers' capabilities and valued functionings in teaching environmental content in Grade 8 Natural Sciences.

Supervisor: Miss Z Songqwaru

Decision: Approved

This letter confirms the approval of the above proposal was noted at the meeting of the Faculty of Education Higher Degrees' Committee on 5 October 2017.

The proposal demonstrates an awareness of ethical responsibilities and a commitment to ethical research processes. The approval of the proposal by the committee thus constitutes ethical clearance.

Sincerely

A handwritten signature in black ink, appearing to read 'M. Schäfer'.

Prof Marc Schäfer
Chair of the EHDC, Rhodes University
6 November 2017

APPENDIX R: LETTER OF CONSENT TO NORTH WEST PROVINCIAL DEPARTMENT OF BASIC EDUCATION

No. 10203 Tsetse Village
Mahikeng
2752
15 – 09 – 2017

North West Department of Education and Sport Development
Ngaka Modiri Molema,
10 Nelson Mandela Drive,
Mahikeng
2745

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT SCHOOLS

Dear Mr Monale,

My name is Kgomotso Thomas, and I am a Masters (M.Ed) student at Rhodes University in Grahamstown. My research interest is in exploring how Natural Sciences teachers teach environmental content topics in their classrooms, and how the Professional Support Forum (PSF) can contribute to their professional development related to this. This research will be conducted under the supervision of Ms Zintle Songqwaru (z.songqwaru@ru.ac.za).

In order to conduct this research I would like to work with schools in Mahikeng sub-district (names will be provided once permission has been granted by school principals). I therefore seek formal consent to approach the schools' principals, Natural Sciences teachers, the learners and the parents of the learners in their classes as participants for this research. The research will require interviews with teacher and an observation of two lessons where the environmental content in the curriculum is taught.

Please find attached a copy of my research proposal which includes copies of the consent and assent forms to be used in the research process. Once I have received ethical clearance from Rhodes University, I will provide you with the ethical clearance letter. I undertake to ensure that all the information gathered will be presented in such a way that the school and all participants are protected.

Upon completion of the study, I undertake to make available to the Department and the teachers my research findings. Should you have any queries, please do not hesitate to contact me on 081 577 7923 and kgomotsomthomas@gmail.com

Thank you for your time and looking forward to your positive response.

Yours sincerely,

Kgomotso Thomas (student number: 17t5788)

Rhodes University

APPENDIX S: PERMISSION LETTER FROM DEPARTMENT OF EDUCATION DISTRICT OFFICE



Education and Sport Development
Department of Education and Sport Development
Departement van Onderwys en Sport Ontwikkeling
Lefapha la Thuto le Tihabololo ya Metsamakeko
NORTH WEST PROVINCE

10 Nelson Mandela Drive,
Mafikeng
Private Bag X10,
Mmabatho 2735
Tel: (018) 388-1964 / 3383
Fax: 086 513 9881 / (018) 381-8299
e-mail: bmonale@nwpg.gov.za
o-mail: omolete@nwpg.gov.za (Off. Man.)

NGAARU MOLELE MOLELE DISTRICT

Enquiries S.O. Molete
Telephone 018 - 388 - 3383

To : Sub District Manager
Circuit Managers
School Managers
Mahikeng Sub District

From : Mr B.E. Monale
District Director

Date : 13 November 2017

PERMISSION TO CONDUCT A RESEARCH IN SCHOOLS (SENIOR PHASE SCHOOLS)

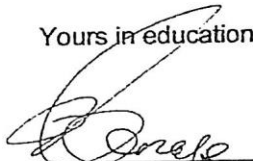
Permission is hereby granted to Ms Kgomotso Emily Thomas, Student No.: 17T5788, who is a Masters Student at Rhodes University to conduct a research on *"An exploration of how professional learning communities can contribute to development of teachers' capabilities and valued functionings in teaching environmental content in Grade 08 – Natural Sciences"*.

School Managers are herewith requested to provide her with support during the research process and necessary support.

Permission is granted on the basis that prior arrangement is made with School Managers to avoid disruption of learning and teaching.

Your cooperation and support in this regard is highly appreciated

Yours in education,


Mr B.E. Monale
District Director

"Towards Excellence in Education and Sport Development"



APPENDIX T: SCHOOL ACCESS APPLICATION

No. 10203 Tsetse village

Mahikeng

2752

15 – 09 – 2017

The Principal
X Science High School
Unit 9, Mmabatho
2735

Dear Sir,

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT X SCIENCE HIGH SCHOOL

My name is Kgomotso Thomas, and I am a Masters (M.Ed) student at Rhodes University in Grahamstown. My research interest is in exploring how Natural Sciences teachers teach environmental content topics in their classrooms, and how the Professional Support Forum (PSF) can contribute to their professional development related to this. This research will be conducted under the supervision of Ms Zintle Songqwaru (z.songqwaru@ru.ac.za).

In order to conduct this research I would like to use your school's Grade 8 Natural Sciences classes. I therefore seek formal consent to approach your NS teacher, the learners and the parents of the learners in her class as participants for this research. The research will require interviews with teacher and an observation of two lessons where the environmental content in the curriculum is taught. For this reason I request to your permission to visit your school in the first five weeks of first term.

Please find attached copies of the consent and assent forms to be used in the research process. Also attached is my ethical clearance letter from Rhodes University, and a permission letter from the Department of Education. I undertake to ensure that all the information gathered will be presented in such a way that the school and all participants are protected.

Upon completion of the study, I undertake to make available to you and the teachers my research findings. Should you have any queries, please do not hesitate to contact me on 081 577 7923 and kgomotsothomas@gmail.com

Thank you for your time and looking forward to your positive response.

Yours sincerely,

Kgomotso Thomas (student number: 17t5778)

Rhodes University

APPENDIX U: LETTER OF INVITATION TO PARTICIPANTS

No 10203 Tsetse Village
Mahikeng
2052
16 – 09 – 2017

Natural Sciences teacher
X Science High School
Unit 9, Mmabatho
2735

Dear Sir/ Madam

Re: Invitation to participate in a research study

You are invited to participate in a research entitle “ an exploration of how professional learning communities can contribute to development of teachers’ capabilities and valued functionings in teaching environmental content in Grade 8 Natural Sciences”. The aim of the research is to understand various things teachers may value doing or being (functionings) in teaching environmental content in Natural Sciences, and in the PSF, and the constraining and/or enabling factors related to these.

The research will be conducted through classroom observations, PSF observations, questionnaires, focus groups, and individual interviews. Your participation is anonymous and your identity will not be made known. The collection of this data will be done throughout the first term. Observation of two lessons will be done and at least interviews of approximately an hour.

Should you agree to participate in this research study, I will provide you with the information you need to understand the research, and explain in more detail what your involvement entails at the first PSF meeting. Once this research study has been approved by the Ethics Committee of the Faculty of Education the letter of ethical approval will be sent to you.

Your participation in this study is voluntary and by responding to this letter you are not obliged to take part in this research. If you agree to participate you will be asked to sign a consent form to confirm that you understand and agree to the conditions, prior to completing the questionnaires, participating in interviews, and classroom observation. Please note that you have the right to withdraw at any given time during the study.

I look forward to hearing from you and hope that you will respond favourably to my request.

Yours sincerely,

Kgomotso Thomas

APPENDIX V: PROGRESSION OF ENVIRONMENTAL STUDIES FROM THE INTERMEDIATE PHASE TO FURTHER EDUCATION AND TRAINING (CAPS)

Grade	Strand	Topic	Content
4	Life and Living	Different habitats	<ul style="list-style-type: none"> • a habitat is the place where a plant or animal lives • there are different kinds of habitats such as grassland, forest, river, sea <p>Need for a habitat</p> <ul style="list-style-type: none"> • animals need a habitat for food, water, a place to shelter, have babies and escape from dangers
5	Life and Living		<p>Plants and animals, and their habitats make up the total biodiversity of the Earth)</p> <p>Many different plants and animals</p> <ul style="list-style-type: none"> • there are many different plants and animals living in different habitats on Earth <p>* (South Africa has a wide variety of indigenous plants and animals and their habitats)</p> <p>Inter-dependence</p> <ul style="list-style-type: none"> • plants and animals depend on each other • they also depend on the resources available (such as air, water, soil, food, and places to hide) in their own habitats <p>Animal types</p> <ul style="list-style-type: none"> • there are many different kinds of animals, some do not have bones, and some have hard outer ‘skins’ or shells (invertebrates), some have bones (vertebrates) <p>Food and feeding</p> <ul style="list-style-type: none"> • Green plants make their own food*and build their branches and stems using water and carbon dioxide from the air, and energy from sunlight. Plants use carbon dioxide from the air and release oxygen into the air • animals need food to carry out their life processes (to move, feed, grow, sense the environment, excrete, breathe and reproduce) • all animals depend on plants as their primary source of food (herbivores, carnivores and omnivores) • a food chain describes the feeding relationships between plants and animals. • a food chain starts with a plant, (produces foods) then follows with an animal that eats the plant after that with an animal that eats that animal includes the transfer of energy which flows from the plant through to the last animal in the chain
6	Life and Living	Different ecosystems	<ul style="list-style-type: none"> • an ecosystem is an area where living and non-living things depend on each other in many different ways

		Food webs	<ul style="list-style-type: none"> • there are many different ecosystems such as rivers, mountains, sea, rocky shore, ponds, wetlands, grasslands, forests and deserts, which support different kinds of living things <p>Living and non-living things in ecosystems</p> <ul style="list-style-type: none"> • in an ecosystem there are certain relationships between living things (plants, animals/people, microorganisms), and non-living things (air, water, sunlight, soil) in a particular area • In an ecosystem plants and animals are connected by their feeding relationships. This is called a food web • a food web consists of: <ul style="list-style-type: none"> -plants (producers) which produce food for themselves and animals - animals (consumers) which are herbivores, carnivores, omnivores -microorganisms (decomposers) that break down dead plant and animal matter and return nutrients to the soil
7	Life and Living	The biosphere Biodiversity	<p>The concept of the biosphere</p> <ul style="list-style-type: none"> • the biosphere is where life exists and includes the lithosphere (soil and rocks), hydrosphere (water), and atmosphere (gases) • it also includes all living organisms, and dead organic matter • there are many different kinds of living things including plants, animals, microorganisms • all living things can carry out all the seven life processes: nutrition (feeding), growth, reproduction, respiration (energy production), excretion, sensitivity (to the environment), movement of Earth and its biosphere <p>Requirements for sustaining life</p> <ul style="list-style-type: none"> • living things need energy, gases, water, soil and favourable temperatures • living things are suited (adapted) to the environment in which they live, such as fish have fins to move easily through water <p>Classification of living things</p> <ul style="list-style-type: none"> • plants, animals and microorganisms, and their habitats make up the total biodiversity of the Earth • living organisms are sorted and classified according to their shared characteristics • scientists have grouped the organisms into a classification system • the five main groups (called Kingdoms) of living organisms include Bacteria, Protista, Fungi, Plants and Animals • basic differences in processes such as movement, nutrition and reproduction, distinguishes plants from animals

		<p>Variation</p>	<ul style="list-style-type: none"> • Kingdoms are further subdivided into Phyla/Divisions, then Classes, then Families, then Orders, then Genera, and the smallest group is Species <p>Diversity of animals</p> <ul style="list-style-type: none"> • animals are classified as either vertebrates (animals with backbones) or invertebrates (animals without backbones) • vertebrates are subdivided into five classes on the basis of distinguishing characteristics: <ul style="list-style-type: none"> -- Fish -- Amphibians -- Reptiles -- Birds -- Mammals • invertebrates are subdivided into the Phyla Arthropoda and Mollusca, on the basis of distinguishing characteristics • arthropods have a hard outer covering (exoskeleton) and jointed legs, such as Insects (locust), Arachnids (spider), Crustaceans (crab) • Molluscs are soft bodied animals such as snails <p>Diversity of plants</p> <ul style="list-style-type: none"> • plants are classified as plants with seeds (such as maize) or plants without seeds (such as ferns) • plants with seeds are Angiosperms (flowering plants) and Gymnosperms (cone bearing plants such as the cycad) • plants can produce their seeds in flowers (Angiosperms) or in cones (Gymnosperms) • Angiosperms consist of two major groups, dicotyledons and monocotyledons. These groups differ with respect to their roots, stems, leaves, flowers, fruits and seeds <p>[Note: Emphasise local and other South African examples].</p> <p>Variations exists within a species</p> <ul style="list-style-type: none"> • A species is a category within the classification system. Living things of the same type belong to the same species. For example, humans are one species and dogs are another species • individuals of the same species can reproduce to make more individuals of the same species • all people are human (Homo sapiens) and belong to the same
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			<p>species</p> <ul style="list-style-type: none"> • differences between living things of the same species is called variation • Variation amongst humans can be inherited. Some inherited characteristics are height and tongue-rolling
8	Life and Living	Interactions and interdependence within the environment	<p>Introduction to ecology</p> <ul style="list-style-type: none"> • ecology is the study of interactions of organisms with one another and with the physical and chemical environment • scientists usually classify the study of ecological interactions into four levels; populations, communities, ecosystem and the biosphere <p>Ecosystems</p> <ul style="list-style-type: none"> • all ecosystems combined make up the biosphere • an ecosystem consists of an ecological community that includes all living organisms (biotic) such as plants and animals, together with the non-living (abiotic) environment such as temperature, wind, water, interacting as a system • the size of an ecosystem is not specifically defined and it usually encompasses a specific, limited area (although it can encompass the entire planet) • ecosystems are defined by the network of interactions among organisms, and between organisms and their environment • survival of individual organisms and populations depends on the its ability to cope with changes (adapt) in its habitat (the place where an organism lives) or in the ecosystem <p>Feeding relationships</p> <ul style="list-style-type: none"> • Plants are producers. They make their own food • Animals are consumers. They obtain food from plants either directly (such as herbivores) or indirectly (such as carnivores) • herbivores: feed on plant material (for example cows, horses) • Carnivores: feed on other animals (living or dead). The group includes: <ul style="list-style-type: none"> - those that hunt other animals (prey) are predators (for example leopards) - those that eat dead animals are scavengers (for example hyenas, vultures) -insectivores feed mainly on insects and other smaller invertebrates such as worms (for example earthworms) • omnivores: feed on plants and animals (for example humans)

			<ul style="list-style-type: none"> • decomposers: breakdown (decompose) the remains of dead plants and animals. They recycle important nutrients in the environment (for example bacteria, fungi, earthworms) <p>Energy flow: Food chains and food webs</p> <ul style="list-style-type: none"> • plants (and algae) play an important role in the ecosystem, as they capture energy from the Sun by the process of photosynthesis • this energy is passed along a food chain from producers to consumers; decomposers are the last link in this transfer of energy and release energy as heat to the environment • each stage of a food chain is called a trophic level • energy transfer and energy loss occur at each trophic level • interlinked food chains together form food webs <p>Balance in an ecosystem</p> <ul style="list-style-type: none"> • an ecosystem can only accommodate as many organisms as its resources (food, water and shelter) can carry, and it will fail if it does not remain in balance • this balance can be disrupted by natural and human factors <p>-natural factors include extreme changes in patterns of weather and climate, such as floods, drought, extreme and sudden changes in temperatures</p> <p>-human factors include removing organisms from the ecosystem (such as poaching), human induced pollution</p> <ul style="list-style-type: none"> • these factors can contribute to an imbalance in an ecosystem, seriously impacting on its components and altering its nature <p>Adaptations</p> <ul style="list-style-type: none"> • adaptation is the change in the structural, functional and behavioural characteristics of an organism • adaptation allows the organism to survive as it adapts to changing conditions within the environment • organisms that are unable to adapt to changes within the environment die out (become extinct) <p>Conservation of the ecosystem</p> <ul style="list-style-type: none"> • environmentalists and others work towards managing ecosystems, such as control of alien vegetation and preservation of wetlands • individuals can contribute to conservation in various ways, such as appropriate waste disposal (including recycling, reusing
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10	Life and Living	Environmental studies	<p>Biosphere</p> <ul style="list-style-type: none"> • The concept of the biosphere. • The inter-connectedness with and components of the global ecosystem: the hydrosphere, lithosphere and <u>atmosphere (Links to Grade 8)</u>. <p>Biomes</p> <ul style="list-style-type: none"> • Terrestrial and aquatic biomes of southern Africa and how climate, soils and vegetation influence the organisms found in each. • The location of the different biomes in South Africa. <p>Environment</p> <p>The concept of environment in terms of human activities in and interactions with the natural environment. Abiotic and biotic factors: effects on the community.</p> <p>Ecosystems</p> <p>The concept of ecosystem, structure and ecosystem functioning:</p> <ul style="list-style-type: none"> • Abiotic factors: <ul style="list-style-type: none"> - physiographic factors (aspect, slope, and altitude) - soil (pH, humus content, texture, water retention capacity and air content) - light (day length and seasonal changes) - temperature (effect of day/night and seasons) - water (water cycle and the importance of wetlands) - atmospheric gases (<u>link to pollution-Grade 12</u>); and - wind (link to transpiration). - Biotic factors, which include: <u>(Links to Grade 8)</u> <ul style="list-style-type: none"> - producers - consumers - decomposers. • Energy flow through ecosystems and relationship to trophic structure (food pyramids): <ul style="list-style-type: none"> - Trophic levels: producers, consumers (herbivores and carnivores and omnivores), decomposers (<u>link with Grade 9 and nutrition in Grade 11</u>); - Flow charts of the following: nutrients water, oxygen, carbon and nitrogen cycles (Names, e.g., nitrates are required but no detail of chemistry is necessary) • Ecotourism: <ul style="list-style-type: none"> - economics - ethics - opportunities <p>Diversity, change and continuity:</p>
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			<p>Biodiversity Enormous biodiversity on Earth (large variety of species, different ecosystems and genetic differences) with an emphasis on the extent of biodiversity and endemism in southern Africa: indigenous and endemic species.</p> <ul style="list-style-type: none"> • Classification Schemes <p>Classification schemes are a way of organising biodiversity</p> <ul style="list-style-type: none"> • Brief history of classification: Scientists attempt to classify organisms based on shared features. As information increases classification changes. One of the currently accepted classification systems is the five-kingdom system: Animalia, Plantae, Fungi, Protista and Monera (Bacteria). • The naming of things in science: species concept and binomial system. Focus on Linnaeus (Carl von Linne) and his role in classification systems: Why do we use Latin? • Differences between prokaryotes and eukaryotes (link to cell structure). • The main groupings of living organisms, diagnostic features of each: <ul style="list-style-type: none"> - Bacteria - Protista - Fungi - Plants - Animals
11		Environmental studies	<p>Population Size</p> <p>Immigration, emigration, mortality, births. Fluctuations. Limiting factors and carrying capacity. Logistic and geometric growth curves with phases.</p> <ul style="list-style-type: none"> • Interactions in the Environment <ul style="list-style-type: none"> - predation: two South African examples of predator-prey relationships: graphs; - competition: <ul style="list-style-type: none"> interspecific: for light, space, water, shelter and food; intraspecific: for food, access to mates, water, space, and shelter; survival is determined by access to the above, ecological niches; - specialisation: competitive exclusion and resource partitioning; discuss one example of coexistence in animals and one example in plants; - parasitism: two examples from South Africa; one species benefits - mutualism: two examples from South Africa; both species benefit; - commensalism: two examples from South Africa.

			<ul style="list-style-type: none"> • Social Organisation: The benefits of herds/flocks (avoidance); packs (hunting); dominance; and the division of tasks (castes) (mention only). • Community change over time: Succession Primary and secondary succession and possible endpoints depending on environmental fluctuations (mention only). • Human Population Reasons for exponential growth: <ul style="list-style-type: none"> - age and gender distributions for different countries, including South Africa; - forecast of South Africa's population growth over the next twenty years and predict possible consequences for the environment. Causes and consequences of the following (relate to conditions and circumstances in South Africa): <ul style="list-style-type: none"> • The atmosphere and climate change <ul style="list-style-type: none"> - carbon dioxide emissions; - concept of 'carbon footprint' and the need to reduce the carbon footprint; - deforestation; - greenhouse effect and global warming: desertification, drought and floods; - methane emissions; - ozone depletion. • Water • Availability: <ul style="list-style-type: none"> - Construction of dams - Destruction of wetlands - Poor farming practices - Droughts and floods - Exotic plantations and depletion of water table - Boreholes and effects on aquifers
12		Environmental Studies(from Grade 11)	<p>Human Impact on the Environment must be completed in Grade 11, but this topic will be examined in both Grade 11 and in the National Senior Certificate at the end of Grade 12. In this knowledge strand, it is important to emphasise the interrelatedness and interdependence of the human impacts and the environment)</p> <p>In order to understand species, speciation, biodiversity and change, it is essential to understand how DNA and chromosomes enable continuity and change)</p> <ul style="list-style-type: none"> • Genes: Dominant and recessive genes and alleles <p>Mention of Mendel, father of genetics</p> <ul style="list-style-type: none"> • Inheritance and variation

		<p>Diversity, change and continuity</p>	<ul style="list-style-type: none"> - Monohybrid crosses: phenotype and genotype, homozygous and heterozygous (pure bred and hybrid); examples of complete, incomplete/partial dominance and codominance; - Dihybrid crosses: phenotypes and genotypes. • Sex chromosomes Sex-linked alleles; sex-linked diseases • Mutations - harmless and harmful mutations: examples of diseases, disorders; gene mutations and chromosomal aberrations; and - useful mutations, link with natural selection • Genetic engineering: Stem cell research, genetically modified organisms, biotechnology and cloning. • Mention mitochondrial DNA and the tracing of genetic links • Paternity testing and DNA finger printing (forensics)
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APPENDIX W1: Analytical memo 1: Teaching methods and resources used by teachers.

Data extract or summary		Data source
Teaching methods	Resources	
Traditional teaching. Blackboard; explain; worksheets; activities	Anything that can be used as an example	PQT3
Discussion; questions and answer	Textbooks and relevant NS materials	PQT1
During lesson observations the teachers used guided questioning method	Copies of notes from textbook	LO1T1; LO2T1
Group discussions - gives me a chance to see what they understand, probe understanding via question-answer method; learn from each other. The teacher was observed asking learners questions and making presentation of the topics	Textbooks; chalkboard	PQT2 LO1T2; LO2T2
During teaching and learning situation I use presentation method in which I use projectors and posters	projectors with prepared slides and posters related	PQT4
Learners practicals, take learners outside	Textbooks, laptops, teaching aids	PQT5
learner centred teaching method where learners do most of the work and the teacher facilitates	textbooks, models and charts	PQT6
Questions and answers; presentations; sometimes I do practicals	projectors; textbooks; worksheets	PQT7
I use direct teaching. Discussions and practical demonstration	textbook; chalkboard; posters; practical apparatus	PQT8
discussion; observation from visual aids	textbooks and relevant NS models; laptop	PQT9
direct teaching; questions and answers; experiments	textbooks, sometimes I use a computer on projector	PQT10
Most times I would start by introducing the topic, test learners prior knowledge by asking question. Doing quizzes as well	Projector; textbooks; videos; science kit, chalkboard sometimes	PQT11
Questions and answers, giving notes and assessing after the lesson	Chalkboard and books	PQT12
Discussions, direct teaching and practical demonstrations	textbooks, worksheets from teachers guide, summary notes	PQT13

APPENDIX W2: Analytical memo 2: Teachers' valued beings and doings in the PSF

Data extracts or summary	Data source
<p>In the questionnaires teachers identified the professional development activities they participate in:</p> <ul style="list-style-type: none"> • “compulsory to attend PSF and/ or workshops. • “environmental club, and workshops are conducted.” • “continuous Natural Sciences workshops, which means teachers gather and figure out strategies to teach the content a little better and easier” • “Normally we assist each other at PSF ...” • “We do IQMS, but I cannot say it is helpful. I participate in PSF which is compulsory. I watch a lot of TED videos on educational issues. I also participate in SACE CPTD programme” • “I have registered for SACE CPTD, I participate as a judge in Science Expos, and I am part of the PSF.” • “I am a member of a union, I go for departmental workshops and PSFs”. 	<p>PQT3 PQT1</p> <p>PQT2 PQT5 PQT7 PQT11 PQT12</p>

Data extracts or summary	Data source
<p>Teachers want to take more active roles in the PSF</p> <ul style="list-style-type: none"> • And maybe the subject advisor should give teachers who are good in NS to teach us how to teach some of the topics, especially for us new teachers. 	<p>PQT6</p>
<p>Opportunity to have freedom in the planning of the PSF sessions</p> <ul style="list-style-type: none"> • I wish the subject advisor could allow us teachers to come with our own points of discussions. Especially for content discussions • If we could be given an opportunity to say what we as teachers want to discuss 	<p>PQT10</p> <p>PQT8</p>
<p>Content based discussions</p> <ul style="list-style-type: none"> • We need more workshops that deal with administration and then ones that deal with content, that supply past question papers that have been written and then us as teachers we break it down and come up with ways to improve the subjects. • I will like us to discuss content ... • I am interested in discussing content. • We could do with some creativity. Reduce presentations on policies and subject requirements and focus more on subject content... 	<p>PQT1</p> <p>PQT6 PQT8 PQT11</p>

<ul style="list-style-type: none"> • focus on how to teach biodiversity in Grade 7. hear from other teachers, or even have the subject specialist teach the topic, or other teachers • Spend more time discussing subject content, that's what matters at the end of the day" • lack of teacher discussions. We were going to develop if we talked to each other about the subject, and discuss topics every term. So in the PSF there are no subject content discussions every term 	RQT7 FIT2 FIT13
<p>Discussions about other issues related to teaching</p> <ul style="list-style-type: none"> • Concentrate and elaborate on possible classroom activities • strategies towards our challenges we face in different workplace 	PQT3;FIT3 RQT5
<p>To have different facilitators</p> <ul style="list-style-type: none"> • ... organise specialists to conduct the PSF • regarding the PSF, it would be helpful if the subject advisor invites companies/organisations to workshop us on different topics. Like she did sometime inviting SAASTA to train us the topic Earth and Beyond • The PSF need something different or even different facilitators 	PQT9 RQT7 RQT12
<p>Being supplied with more teaching and learning resources</p> <ul style="list-style-type: none"> • Being provided with all resources for teaching NS • I need more teaching resources • Be provided with more materials for assessment • I would love to have previous question papers...also practical experiments as in our school that is a challenge. • I also want teaching materials like past question papers and extra worksheets. 	RQT6 RQT13 RQT11 RQT2 FIT3
<p>Frequent PSF meetings and extended time of sessions</p> <ul style="list-style-type: none"> • "More PSF to be held so that progress can be measured"; "To increase the dates of meetings" • "...increase the number of meetings, maybe twice per term" • "once-a-term PSFs are not sufficient" • "...and meet more often" • "if the Department can schedule PSF meetings during schools holidays to allow us more time ... two hours is not enough." • "They should increase the workshop time maybe to 3 hours. Also if the workshops were held during school holidays so that they don't interfere with teaching time". • We should also meet more than once. Meeting often will enable us to help each other in different topics. 	RQT1; PQT1 RQT8 RQT11 PQT6 PQT7 FIT6
More hands-on activities	RQT11
Have sessions designed specifically for new teachers for orientation	

<ul style="list-style-type: none"> • if they could have separate sessions. For us new teachers and then advanced ones. • I think it would be better if there could a separate PSF for the purpose of admin and orientation for new teachers • I have a perfect structure (laughs). Okay. Here is my ideal PSF. The beginning of the year we must have two sessions. The first one is for teachers who are new in NS. That session should be all about inducting the teachers; where we talk about requirements, ATPs, work schedules, files etc. Then we hold a second session with all teachers and we discuss all the topics for term one. There should be different times for Grade 7 to 9. Discussions should be done per term. Right at the beginning of the term. And us teachers should get more time to talk. 	<p>PQT13</p> <p>RQT8</p> <p>FIT13</p>
<p>The use of ICT in the PSF</p> <ul style="list-style-type: none"> • Can in anyway the facilitators bring overhead projectors and speakers so that everyone can receive information 	<p>PQT4</p>
<p>Learning new teaching strategies from each other</p> <ul style="list-style-type: none"> • Give teachers space to share teaching techniques in the subject • discuss exam questions and new teaching strategies (especially the use of ICT) • Methods that teachers use that are more simplified • Explanation of activities (formal) needed and how to address them 	<p>PQT11</p> <p>PQT8</p> <p>RQT2</p> <p>RQT1</p>
<p>Networking with other teachers</p> <ul style="list-style-type: none"> • Interaction and learning from other teachers and improve my knowledge and skills • Making contact with teachers from other schools, who joined us for the first time. It means more networks for me • I did gain more knowledge and made a wide range of networking with other teachers 	<p>RQT4</p> <p>RQT7</p> <p>RQT9</p>

