

Continuing teacher professional development in the Environment Sector:

A case study of Fundisa for Change

continuing teacher professional development programme

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ABSTRACT

The importance of teachers being engaged in professional development initiatives is widely acknowledged in the literature and in most cases these initiatives are largely focused on addressing teachers' lack of subject content knowledge. The problem of teachers having inadequate environmental knowledge is common in South Africa due to the fact that much of the environmental content knowledge in the curriculum is new, and environmental education itself is a new field. This is an area of interest in South Africa as a third iteration of the post-apartheid curriculum, the Curriculum and Assessment Policy Statement (CAPS) has recently been introduced into schools and many subjects have environmental learning content. Inadequate subject content knowledge influences teachers' abilities to choose appropriate teaching and assessment methods and this might negatively affect the process of teaching and learning. Knowledgeable teachers are needed to help learners understand the current issues affecting citizens, and in particular, environmental issues, which form the focus of this study.

The main research questions addressed are:

1. What are the teachers' experiences of the Fundisa for Change continuing teacher professional development programme in relation to environment and sustainability content knowledge?
2. How does the Fundisa for Change continuing teacher professional development programme influence teachers' practice?
3. What practices of the Fundisa for Change teacher professional development programme are characteristic of effective continuing teacher professional development initiatives?
4. How are (if at all) the practices of teacher training, teacher learning, teaching and assessment of Biodiversity content in CAPS living practices?

This work was conducted as a qualitative case study and it was carried out in the provinces of Gauteng, Eastern Cape and Mpumalanga in South Africa. It included four teachers from the Eastern Cape and five from Mpumalanga. Seven teacher trainers also participated, two of which were based in Gauteng and the rest in the Eastern Cape. Data were generated through interviews and document analysis, and included analysis of teacher portfolios showing evidence of classroom practice. The study explored teachers' experiences of an environmental education training programme called 'Fundisa for Change', which has been set up as a national

partnership initiative to strengthen teachers' environmental knowledge and teaching skills in order to address the above-mentioned problem. It focused on training teachers in the Life Sciences, particularly on new content knowledge on Biodiversity, and on teaching and assessment skills. It also looked into how the training influenced teaching practice. The study worked with practice theory, in particular Kemmis and Grootenboer's (2008) theory of practice architectures, to look at the sayings, doings and relatings pertaining to the teaching of Biodiversity, and the enabling and constraining of this practice. The features and the teachers' experiences of the Fundisa for Change professional development programme have been presented and explained. The study also used the ecologies of practices theory to describe the living nature of practices. The following are the key findings:

- The Fundisa for Change programme improved the participating teachers' Biodiversity content knowledge, teaching and assessment skills.
- Practices of the Fundisa for Change teacher professional development programme characteristic of effective continuing teacher professional development initiatives are: duration; active involvement of teachers; providing teachers with subject content knowledge; promoting establishment of professional learning communities; coherence; follow-up; and assessment of teachers.
- The conditions that affect the participating teachers' teaching practice are: the use of language (both scientific and instructional); infrastructure (availability of computer laboratories, science laboratories, extra classrooms and libraries); teaching and learning support materials including laboratory apparatus; class size; and policies.
- The Fundisa for Change programme encourages teachers to improvise and use the local environment in their teaching to try to tackle the problem of lack of funds and equipment.
- Teaching Biodiversity practice is 'living' as it is characterised by the principles of living ecologies.

Recommendations based on the findings are:

- There is a need for more teacher training by Fundisa for Change and other organisations whose training activities are SACE approved to cater for more teachers.
- A more structured plan of action from the Department of Basic Education (DBE) is needed to assist and involve more organisations and stakeholders.

- Provision of infrastructure and teaching and learning resource materials to schools by the DBE needs to be accelerated as it is legally binding.
- Follow-up should be formally incorporated into Fundisa for Change programme activities.
- Formation of professional learning communities is very important to help new teachers as there is no formal induction programme in South Africa.
- An induction policy by the DBE needs to be formulated to help establish an induction programme for newly qualified teachers.

Recommendations for further research are:

- Use of lesson observation for data collection to improve results.
- A larger sample could be used to expand the insights gained in this study.
- Fundisa for Change practices can be studied at the level of teacher professional development practices.
- Other modes of teacher professional development initiatives such as Lesson Study can be tested out to overcome the challenge of teachers not wanting to be observed.
- More research can be carried out on the practices of teacher training, teacher learning, student learning and assessment, as practices associated with teaching Biodiversity.

The study was important in that it gave an understanding of what makes continuing teacher professional development initiatives effective. The study also looked at teaching Biodiversity through the use of contemporary forms of a practice theory which are the theory of practice architectures and the theory of the ecologies of practices. This provided understandings into how professional development programmes are experienced in practice, and showed that though the teachers were trained and positive benefits accrued, there are factors which enable or constrain their actual teaching Biodiversity practice. The study also showed that practices are interrelated in ecologies of practices. These factors need to be considered in professional development programming.

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ACRONYMS

ACE: Advanced Certificate in Education
CAPS: Curriculum Assessment and Policy Statement
CPD: Continuing Professional Development
DBE: Department of Basic Education
DEAT: Department of Environmental Affairs and Tourism
DHET: Department of Higher Education and Training
EC: Eastern Cape
ECS: Eastern Cape School
ECT: Eastern Cape Teacher
EfS: Education for Sustainability
ELRC: Environmental Learning Research Centre
ESD: Education for Sustainable Development
FCR: Fundisa for Change Training Programme Final Report (2013 – 2015)
FCU1-2017: Fundisa for Change Training Programme Update 1 for 2017
FCU2-2017: Fundisa for Change Training Programme Update 2 for 2017
FET: Further Education and Training
GAP: Global Action Programme
HOD: Head of Department
ID: Identity (for research participant)
IP: Fundisa for Change Implementation Plan
IQMS: Integrated Quality Management System
LS-CAPS: Life Sciences Curriculum and Assessment Policy Statement
MP: Mpumalanga
MPS: Mpumalanga School
MPT: Mpumalanga Teacher
MSSI: Mpumalanga Secondary Science Initiative
NCS: National Curriculum Statement
NICPD: National Institute for Curriculum and Professional Development
NSC: National Senior Certificate
OBE: Outcomes-Based Curriculum
PD: Professional Development

PGCE: Postgraduate Certificate in Education
PLC: Professional Learning Community
PTC: Primary Teachers' Certificate
RNCS: Revised National Curriculum Statement
SANBI: South African National Biodiversity Institute
SAPA: South African Press Association
STC: Secondary Teachers' Diploma
TT: Teacher Trainer
UN: United Nations
UNDESD: United Nations Decade of Education for Sustainable Development
UNESCO: United Nations Educational, Scientific, and Cultural Organisation
UNESCO-UNEP: United Nations Education, Scientific, and Cultural Organisation-United Nations Environment Programme
WESSA: Wildlife and Environment Society of South Africa
WCED: Western Cape Education Department

CHAPTER 1: INTRODUCTION

1.1 Introduction

This chapter describes the context of the study. It introduces the aim, the goals and the main study questions. It further describes the contextual profile of the study sites and provides an overview of the study.

1.2 Context of the study

The South African government has phased out the old National Curriculum Statement (NCS) Grades R–12 which had elements of an Outcomes-Based Education (OBE) curriculum, and a new curriculum called Curriculum and Assessment Policy Statement (CAPS) has been fully implemented in all grades. This means that CAPS is a revised NCS Grades R-12 of 2002 and the NCS Grades 10 -12 of 2004 (NCS Grades R-12, 2010). The development of an inclusive curriculum catering for the needs of all South Africans began in 1994 after the abolition of apartheid. Prior to this period, the South African Education system was racially divided. This meant that certain racial groups such as the ‘whites’ were advantaged in terms of resource allocation and better education, which prepared them for better opportunities in the future. They were therefore able to secure better jobs and hence were able to access essential services such as good shelter, food and health, to mention a few. With the new post-apartheid curriculum policies that have been developed, issues of racial divisions are being addressed with a single curriculum that is inclusive of all people. It also incorporates the principles highlighted in the Constitution of the Country. As Soudien (2010) explained, “The burden of the new government when it comes [*sic*] into power in 1994 is [*sic*] to break with country’s apartheid past” (p. 40). He went on to say, referring to the words and ideology of Hendrik Verwoerd, that in the apartheid era, black people were meant to be so poorly educated that their training would only allow them to cut wood and to fetch water (Soudien, 2010, p. 41).

The first curriculum to be developed in 1997 in a democratic South Africa was Curriculum 2005, which later was revised and renamed the Revised National Curriculum Statement (RNCS) in 2002 (Soudien, 2010, p. 41). This curriculum was based on the principles of Outcomes-Based Education (OBE) which rely on learners achieving certain stated outcomes, as opposed to them gaining deep subject content knowledge, hence it was called OBE. OBE was introduced into the schooling system in 1998. From inception, OBE had been criticised

(Soudien, 2010, p. 42) by some leading academics such as Dr Mamphela Ramphele and Professor Jonathan Jansen (Jansen, 1998). When the Minister of Basic Education, Ms Angie Motshekga officially announced the phasing out of OBE in parliament, she said:

The question on everyone's lips is why we do not, as Mamphela Ramphele always wants us to do, declare the death certificate of outcomes-based education, OBE? I must say that we have, to all intents and purposes, done so. So if anybody asks us if we are going to continue with OBE, we say that there is no longer OBE. We have completely done away with it. (Motshekga, 2009)

Soon after its introduction, Jansen (1998) discussed ten reasons why OBE would fail in South Africa. These included: the language of OBE being too difficult for the teachers to understand; OBE emphasising learner outcomes rather than content; OBE requiring highly trained and skilled teachers to deliver it effectively; and OBE requiring a lot of time from teachers doing administrative work instead of focusing on the core business of the school, which is teaching and learning. Olivier (2009) praised Dr Mamphela Ramphele for having openly and courageously told the government that OBE was failing in South Africa, while the majority of teachers shared the same idea but could not say so publicly. The teacher professional development initiatives by the South African government for the implementation of OBE also proved to be inadequate (Ono & Ferreira, 2010, p. 59). It was this pressure from different sections of society which eventually led to the development and implementation of CAPS.

The implementation of a new curriculum comes with its own challenges. One of the challenges is some teachers lack skills and knowledge that are expected of them to effectively implement the new curriculum. These challenges can be attributed to several factors, one of which is that some teachers did not get proper training during apartheid, as noted above. Another is that even some newly qualified teachers, including those currently training, emerge from the training system without appropriate skills, or are insufficiently competent because some universities through their own histories of disenfranchisement paradoxically offer poor teacher education (Lotz-Sisitka & Songqwaru, 2013, p. 5). It is at this point that continuing teacher professional development initiatives, such as the Fundisa for Change programme, are needed to re-skill or up-skill practising teachers.

CAPS focuses on subject content knowledge, pedagogical content knowledge and assessment. More content knowledge on environment and sustainability issues has been included in CAPS,

particularly in Life Sciences, Geography, Life Orientation and Technology (Lotz-Sisitka & Songqwaru, 2013, p. 5). This further warrants implementation of continuing teacher professional development initiatives as much of this content knowledge is new to teachers and it is highly contentious (*ibid.*).

Currently, this is the first study undertaken in the field of environmental education that has a focus on practice architectures and practice ecologies, as these relate to continuing teacher professional development programmes. Developing a better understanding of continuing teacher professional development practices and their relationality to teaching practices would seem to be important to teacher education in South Africa, since teaching is generally understood as being a practice (Green, 2009; Hemmings et al., 2013; Kemmis, 2005; Kemmis & Heikkinen, 2011; Kemmis & Mutton, 2012; Kemmis et al., 2014). Kemmis, who has been instrumental in developing the theory of practice architectures including via the use of practice ecologies (as outlined in Chapter 2) explained the rationale for understanding professional practices from the perspective of practical reasoning from this perspective. He talked about three types of reasoning when describing the nature of practice: practical, theoretical and technical reasoning (Kemmis, 2005, p. 392). He further indicated that technical reasoning is about “the production of something, and it is characteristically guided by a disposition called *poietike* or ‘making-action’”; theoretical reasoning is about “the attainment of knowledge for its own sake”; and practical reasoning is about “practical wisdom and knowledge” and is characterised by “*praxis* – ‘doing-action’...” (*ibid.*) (emphasis original). Kemmis emphasised that practical reasoning is not only based on inherent professional practice knowledge but also on “one’s own and others’ intentions, understandings, meanings, values and interests, and on one’s own and others’ reflexive, unfolding understandings of the situation in which one is practising at any given moment” (*ibid.*). This is very important for teachers, especially in South Africa given the challenging conditions some teachers find themselves working under. Kemmis further indicated that being reflexive in a practice is an important element of *praxis* and it is also one of the qualities of expert practitioners (*ibid.*). Carr (2009) added that *praxis* is a “morally committed action in which, and through which, our values are given practical expression” (p. 60), and this human action develops from what Aristotle called *phronesis* (*ibid.*). This demonstrates that practices are social entities as will be explained further in the next chapter.

There is a strong rationale for thinking about continuing teacher professional development practices as relationally constituted with teaching practices. How the continuing teacher

professional development programme can potentially shape and influence the ‘unfolding actions’ of teachers is what is of value here. This is because of the significance and importance being placed on continuing teacher professional development for improving classroom practices as intended in Department of Basic Education (DBE) and Department of Higher Education and Training (DHET) (South Africa, DBE & DHET, 2011) policy on continuing teacher professional development. In the context of environmental education, this is especially important as much of the environmental knowledge that teachers need to deal with from the CAPS perspective is often new to them, and the continuing professional development programme has a potentially powerful role to play in supporting the ‘unfolding actions’ of teachers as they teach this new knowledge using pedagogy and assessment processes. Kemmis (2005) argued that, in order to address the pervasive ‘rationalism’ that characterises the modern world, and which often manifests as a narrow focus on notions such as ‘professional practice knowledge’ there is need to more fully understand how teachers think in the course of doing a practice, and what influences this thinking and how. He, together with Green (2009), pointed to the limitations of focusing only on knowledge or expansion of teachers’ professional knowledge, rather than *their practice* and how it is shaped by and through teacher professional development programmes. It is here that this study can potentially make its new contribution to knowledge, especially also as this relates to:

- Understanding teaching Biodiversity (in South African context) through a practice architectures’ lens. I have not come across any study which uses either practice architectures or ecologies of practices to look at continuing teacher professional development locally. Most of the research studies internationally which use practice architectures focus mainly on the induction of newly qualified teachers, showing that there is a gap in knowledge of such a perspective from a continuing teacher professional development point of view. Additionally, studies using ecologies of practices are very rare since this is a new theory (Kemmis et al., 2014), and these have been carried out internationally, not in South Africa.
- Understanding teacher training, teacher learning, teaching and assessment of Biodiversity content in CAPS, and their ecologies (or interrelationships), as living relational entities that have potential to shape the ‘unfolding actions’ of teachers: this is also a new area of research in South Africa.

It is important for people in general to be knowledgeable about what is happening around them, at local and global levels, so that if problems arise, they can respond appropriately. It is also very important to keep up with what is happening because knowledge changes from time to time, especially in the environmental field, which is why environmental education is rapidly growing globally. It is therefore imperative that teachers become aware of, and also understand, these changes in environmental knowledge in order to “help children and young people to make sense of our changing world” (Fundisa for Change programme, 2013, p. 2). Jarvis (2000) supported this notion by saying that “A society is changing so very rapidly, everybody is required to learn new things in order to keep abreast with everything ...” (p. 349). Jarvis (2000) went on to say that knowledge is no longer regarded as “certain and true” but as “something which is changing and relative” (p. 350).

The first post-apartheid teacher development summit was held in South Africa in July 2009 in an effort to bring all stakeholders and interested organisations in education together to discuss problems facing teachers and plan a way forward (South Africa. Department of Basic Education and Department of Higher Education and Training [DBE & DHET], 2011). From this summit an Integrated Strategic Planning Framework for Teacher Education and Development in South Africa for the period 2011-2025 was formulated: “The primary outcome of the Plan is to improve the quality of teacher education and development in order to improve the quality of teachers and teaching” (South Africa. DBE & DHET, 2011, p. 1).

The Fundisa for Change continuing teacher professional development programme (interchangeably used with Fundisa for Change programme here) is an initiative established by a network of governmental, non-governmental and parastatal organisations which have partnered together to professionally develop teachers to implement the environmental and sustainability aspects of the new curriculum (see Appendix A for the full names of the partners). The word ‘Fundisa’ is a Xhosa word meaning ‘teach’. The main objective of the Fundisa for Change programme is to capacitate teachers with the aim of fostering “transformative environmental learning through teacher education” (Lotz-Sisitka & Songqwaru, 2013, p. 6).

Currently this network is co-ordinated by GreenMatter with the assistance from the University of South Africa and the Environmental Learning Research Centre (ELRC) at Rhodes University. The network offers three types of training: the first is the training of the Fundisa for Change partners on how they can support schools in implementing CAPS; the second is the

training of teacher-trainers who run accredited training for teachers at their respective places; the third is training of teachers.

1.3 Research aim, goals and questions

1.3.1 Aim

The main aim of this study is to provide an understanding of how in-service Life Sciences teachers can be best supported to cope with the requirements of the new CAPS curriculum, the main focus being on the Biodiversity component of the environment and sustainability content knowledge in the curriculum. This is done in an attempt to improve their practice and to inform the development of new policies on continuing teacher professional development and future training programmes meant to help teachers implement new curricula, particularly in relation to the environment and sustainability content knowledge.

1.3.2 Research goals

The goals of this research were:

1. To explore teachers' experiences of the Fundisa for Change continuing teacher professional development programme in relation to environment and sustainability content knowledge.
2. To find out how the Fundisa for Change continuing teacher professional development programme influences teachers' practice.
3. To find out what features of Fundisa for Change continuing teacher professional development programme are characteristic of effective continuing teacher professional development activities.
4. To describe the living nature, if any, of teaching Biodiversity, teacher training, teacher learning and assessment of Biodiversity content in CAPS.

1.3.3 Research questions and sub-questions

1. What are the teachers' experiences of the Fundisa for Change continuing teacher professional development programme in relation to environment and sustainability content knowledge?
 - a. What new knowledge, if any, on environment and sustainability is gained by teachers?
 - b. What new ways of teaching, if any, will have been learnt by teachers?
 - c. What new ways of assessment, if any, will have been learnt by the teachers?

- d. What other experiences appear to be significant to teachers in the Fundisa for Change continuing teacher professional development programme?
2. How does the Fundisa for Change continuing teacher professional development programme influence teachers' practice?
 - a. How (if at all) does the training influence the teachers' use of environment and sustainability content knowledge in their teaching?
 - b. How (if at all) does the training influence the way teachers teach Biodiversity topics?
 - c. How (if at all) does the training influence teachers' assessment strategies and practice?
 - d. What are the doings, sayings and relatings in the Fundisa for Change continuing teacher professional development programme as evidenced by the participants?
3. What are the characteristics of the Fundisa for Change continuing teacher professional development programme?
 - a. How (if at all) do these relate to or reflect characteristics of effective continuing teacher professional development?
4. How are (if at all) the practices of teacher training, teacher learning, teaching and assessment of Biodiversity content in CAPS living practices?
 - a. What relationships (if any) exist between these practices?
 - b. How (if at all) are these relationships sustained?

1.4 My research interest

I have worked as a teacher for more than ten years and I have experienced the problems teachers face when the curriculum and the subject content knowledge prescribed by it change. I was fortunate to be studying for the Postgraduate Certificate in Education (PGCE) in 2003 when the OBE curriculum had newly been implemented in schools. I learnt all about the elements of OBE at that time, while at the same time most practising teachers and some of the teacher organisations were speaking out loudly about the little support they were getting from the government towards its implementation.

Teachers in South Africa are currently faced with the challenges of implementing a new curriculum. One of the challenges is the new environmental content knowledge that has been included in the curriculum. Effective implementation of the curriculum requires teachers who are knowledgeable about the subject content they have to teach, the instructional strategies and

how to implement them effectively, and how to effectively assess learning. These are the elements of CAPS that need special attention by the teachers in order to effectively implement it. Environmental Education research has also shown that some South African teachers lack the environment and sustainability content knowledge required to be taught in CAPS. Lotz-Sisitka (2011) commented: “A poor understanding of sustainable development currently exists in schools and amongst teachers, and teachers have little capacity for integrating these issues into teaching and learning” (p. 34). It is in this regard that continuing professional development of teachers is essential. The Fundisa for Change Network is offering this kind of professional development to help teachers in South Africa cope with the new curriculum. As Lotz-Sisitka and Songqwaru (2013) emphasised, the main “developmental objective” of Fundisa for Change Network is “to enhance transformative environmental learning through teacher education” (p. 6). I was interested in knowing what the teachers were saying about the support mechanisms in implementing CAPS, with a particular focus on teaching Biodiversity. I also needed to know why some support mechanisms for in-service teachers work while others fail. The study further looked at the interrelationships between teacher training, teacher learning, teaching and assessment practices.

1.5 Research study sites

This research study was carried out in three provinces: Gauteng, Mpumalanga and Eastern Cape, in the Republic of South Africa. There were sixteen research participants, nine of whom were practising teachers at public schools, only two of them male teachers. The remaining seven participants have contributed to the writing of Fundisa materials and were also trainers. These seven participants were interviewed on the different roles they had played in the Fundisa for Change network. Three of the seven participants have served in the management and coordination of the Fundisa for Change network. All the participants volunteered to take part in the study. Five of the nine participating teachers were from Mpumalanga while the remaining four were from the Eastern Cape. Five of the participating trainers were based at ELRC at Rhodes University in the Eastern Cape, and two were based in Johannesburg in Gauteng. All the schools from which the participating teachers came are no-fee schools, even though in three of the schools parents arranged with the school management to pay school fees.

Three schools among the Eastern Cape schools were situated in urban areas, while the fourth is rural. They are in Mthatha and East London Education Districts. Three schools in

Mpumalanga were rural, while the remaining two were in urban areas. The Mpumalanga schools were in Ehlanzeni and Nkangala regions. The medium of instruction in all the schools was English.

Two groups of participating teachers, one in Mpumalanga and the other in the Eastern Cape, were invited to attend the Fundisa for Change Biodiversity teacher training in 2013. These training programmes were run separately in their provinces by different Fundisa for Change trainers. The teacher training in Mpumalanga was run from 9-12 July 2013 and the one held in the Eastern Cape was from 12-14 July 2013. The trainers running these training workshops had also been trained by Fundisa for Change to equip them with skills and knowledge to train the teachers. Following the training, the teachers were given an assessment task in which they had to compile a portfolio on the Biodiversity lesson they had to teach in order to use the knowledge and implement the skills they had acquired from the training. The targeted sample of the teachers participating in this study was made up of those who managed to submit the portfolio tasks. All the teacher interviews were conducted at the participants' schools, except for two in Mpumalanga, which were conducted in Mbombela, where the participants had gone for a follow-up meeting to get feedback on their portfolio work and to be awarded certificates for successfully completing their portfolio tasks. The following table summarises the information about the participating teachers in this study.

Table 1.1: Participant information: Teachers

ID	Information							
	Gender	Province	District/ Region	School ID	Rural/Urban	Number of		
						Learners	Teachers	Learners per class
ECT 04	F	EC	East London	ECS-4	Urban	754	26	46
ECT 05	F	EC	East London	ECS-5	Urban	623	22	60
ECT 06	F	EC	East London	ECS-6	Rural	773	25	60
ECT 07	F	EC	Mthatha	ECS-7	Urban	675	26	60
MPT 01	F	MP	Nkangala	MPS-1	Rural	1148	34	45
MPT 02	F	MP	Ehlanzeni	MPS-2	Rural	623	23	50
MPT 03	F	MP	Nkangala	MPS-3	Rural	1325	43	60
MPT 04	M	MP	Ehlanzeni	MPS-4	Urban	973	33	50
MPT 05	M	MP	Ehlanzeni	MPS-5	Urban	671	24	45

Abbreviations: ECT (Eastern Cape Teacher); MPT (Mpumalanga Teacher); ID (Participant identity); F (Female); M (Male); ECS (Eastern Cape School); MPS (Mpumalanga School); EC (Eastern Cape); MP (Mpumalanga)

The information regarding the participating teacher-trainers that were interviewed which played different roles in the Fundisa for Change network is given in Table 1.2 below.

Table 1.2: Participant information: Teacher-trainers

ID	Information				
	Gender	Province	Region	Institution	Role in Fundisa for Change
TT 01	M	EC	Makhanda	TT 01-R	Trainer, author
TT 02	F	EC	Makhanda	TT 02-R	Trainer, author
TT 03	F	EC	Makhanda	TT 03-R	Trainer, author, manager
TT 04	F	EC	Makhanda	TT 04-R	Trainer, author, manager
TT 05	F	EC	Makhanda	TT 05-R	Trainer, author, coordinator
TT 06	F	GP	Johannesburg	TT 06-G	Trainer, author, coordinator
TT 07	M	GP	Johannesburg	TT 07-U	Trainer, author

Abbreviations: ID (Participant identity); TT (Teacher-Trainer); F (Female); M (Male); EC (Eastern Cape); GP (Gauteng); EC (Eastern Cape)

1.6 Overview of the study

The chapter that follows explores the theoretical background of the study, which uses the theory of practice architectures and ecologies of practices as the main theoretical lenses for looking into the data collected. It further discusses such concepts as teacher professional development, Environmental Education and CAPS, which frame the study.

Chapter 3 introduces and discusses the methodology and research design used in the study. It describes the research orientation, data-collection methods and tools, data analysis, the research participants, ethical issues, validity and trustworthiness of the study.

Chapter 4 presents the data generated in the study through semi-structured interviews and document analysis. The data is displayed inductively in the form of themes developed from the participants' responses. The themes were also used to develop analytical memos.

Chapter 5 uses an abductive approach to display data through use of the theory of practice architectures' framework. In this chapter the sayings, doings and relatings during the Biodiversity lessons presented by the participants are explored, together with the enabling and constraining factors (the practice architectures).

Chapter 6 also uses the abductive approach in displaying data and the ecologies of practices as a theory is used to look into the data to establish how the practices of teacher training, teacher learning, teaching and assessment of Biodiversity interrelate. The chapter further looks into the possibility of these practices possessing the characteristics of living practices as described by Capra (2005) and Kemmis, Wilkinson, Edwards-Groves, Hardy, Grootenboer and Bristol (2014).

Chapter 7 discusses the findings in the study while highlighting the contribution the study is making in the field of teacher professional development. The findings are presented in the form of analytical statements derived from the analytical memos, and are also related to the literature discussed in Chapter 2. This is done with the main purpose of answering the research questions. It further provides conclusions, recommendations and highlights opportunities for further research.

1.7 Conclusion

This chapter has presented the context of the research study. It has provided insight into its nature, aims and goals. It further introduced the questions the study seeks to answer and the reasons why it was carried out. The sites where the study was carried out were introduced and discussed and a brief profile of the research participants was also provided. Then the layout of the chapters in terms of how they follow each other was provided. The chapter that follows discusses the main concepts in the study and it also provides theoretical lenses for looking into the study.

CHAPTER 2: THEORETICAL AND CONCEPTUAL FRAMING

2.1 Introduction

This chapter describes the theory of practice architectures and the ecologies of practices as the theoretical lenses used in the study. It further discusses the major concepts used in the study, which are teacher professional development, continuing teacher professional development, Environmental Education and CAPS. It highlights some local and international studies on continuing teacher professional development. The chapter further discusses the characteristics of continuing teacher professional development programmes which make them effective.

2.2 Theoretical frameworks

The two theories used in this study have been formulated from practice theory which is centralised around the concept of a practice (Mahon, Kemmis, Francisco & Lloyd, 2017, p. 2). There are many different forms of practice theory (Mahon et al., 2017, p. 2; Kemmis & Edwards-Groves, 2018, p. 121), but the one evolving from Schatzki's ideas and later developed by Kemmis and Grootenboer (2008), and Kemmis et al. (2014) forms the basis of the practice theory used in this study. This particular kind of practice theory is important in that it "politicises practice, humanises practice, theorises relationships between practices, is ontologically oriented, and offers insights pertaining to education" (Mahon et al., 2017, p. 2).

The practice theory from which the theory of practice architectures and later the ecologies of practices theory developed can be traced back to the writings of several authors, some of the most influential ones being Jurgen Habermas, Alasdair MacIntyre, Anthony Giddens and Theodore Schatzki. The idea of 'inter-subjective' spaces or dimensions in which human beings engage with "one another in semantic space, physical space-time and social space" was developed from Jurgen Habermas's "notion of the 'social media' of language, work, and power" (Mahon et al., 2017, p. 223). The theory was also heavily influenced by Alasdair MacIntyre's idea that practices are a product of history (MacIntyre, 2007, p. 190; Mahon et al., 2017, p. 224). MacIntyre (2007, p. 194) went on to say that when one is engaged in a practice, other practitioners are also involved at that particular moment, and as this happens historical achievements by previous practitioners are also acknowledged. This is an act of relating to the current practitioners and those who had laid the foundation in the practice in the past or those

who had set the standard in terms of excellence (*ibid.*). Kemmis acknowledged that the notions of cultural-discursive, material-economic, and social-political arrangements were developed from “Giddens’s three domains of social structure – economic, political and cultural” (Mahon et al., 2017, p. 225).

This research study uses the theory of practice architectures to understand teacher professional development practice in the environment sector in semantic space, physical space-time, and social-political space. This theory was chosen in the study because it provides a three-dimensional way of understanding teacher professional development as a practice, that is, in terms of the language use (discourses), the material or resources available, and the relationships, responsibilities and the roles of the living and non-living entities involved. These are the conditions which enable or constrain the practice of developing teachers in the Fundisa for Change programme. The theory of practice architectures is a new theory which was developed as recently as 2008 by Kemmis and Grootenboer, and is only now gaining popularity among researchers. This makes this study unique in the sense that no other study was carried out either in South Africa or in other countries which looked at the use of practice architectures in understanding in-service teacher professional development and teaching practice in the environment sector. Some studies using this theory have been carried out on induction of new teachers, nursing education, pre-service teacher education, vocational education, higher education and educational leadership (Mahon, 2014, p. 73). The limitation of the theory of practice architectures is that it gives a notion that practices are rigid and stationary, as the word architecture sometimes depicts (Kemmis & Mutton, 2012; Kemmis & Heikkinen, 2011). The theory of ecologies of practices addresses this limitation by introducing the concept of practices being mobile and having interrelationships, introducing a more sophisticated relational perspective on practices and practice architectures (Kemmis & Mutton, 2012; Kemmis & Heikkinen, 2011; Kemmis & Mahon, 2017). This theory is explained in section 2.2.2 below.

2.2.1 The theory of practice architectures

The theory of practice architectures was developed from Schatzki’s practice theory (Hemmings, Kemmis & Reupert, 2013, p. 474). Schatzki (2012) stipulated that practices are organised bundles of sayings and doings, meaning that a particular practice is associated with a distinctive language and distinctive activities and set-ups (p. 14). Kemmis and Grootenboer (2008) went on to say that a practice is also characterised by “relatings” which describe how

people relate to each other and to nonhuman “objects” (p. 46). The relatings aspect of the theory talks about the elements of “solidarity, power, inclusion, exclusion, trust and positionality, all of which can have moral-political significance” (Mahon et al., 2017, p. 16). Kemmis et al. (2012, p.6) as cited by Hemmings et al. (2013, p. 474) talked of a practice as:

... a coherent and complex form of socially established cooperative human activity in which characteristic arrangements of actions and activities (doings) are comprehensible in terms of arrangements of relevant ideas in characteristic discourses (sayings), and when the people and objects involved are distributed in characteristic arrangements of relationships (relatings), and when this complex of sayings, doings and relating “hangs together” in a distinctive project.

What is indicated here is that practices are the products of the language (what people know, think and say about a particular practice), doings (activities people do and the skills they have with respect to that particular practice), and relationships among all the people involved, and between people and objects. It further means that practices have their own characteristic sayings, doings and relatings. A practice such as implementing the Fundisa for Change continuing teacher professional development programme consists of smaller practices which include training of teacher trainers, training of teachers, module development, assessment of teachers, establishing professional learning communities and following up on trained teachers. These smaller practices are all linked together to establish Fundisa for Change continuing teacher professional development programme.

Kemmis and Heikkinen (2011, p. 3) noted that practices are held together in three dimensions, which are:

(1) the semantic dimension (in which it is possible to say things and be understood), (2) the dimension of physical space-time (in which it is possible to perform relevant activities), and (3) the social-political dimension (in which it is possible to relate appropriately to others in the practice).

Practices are also said to exist in three arrangements which are cultural discursive arrangements having to do with the description of the language used, the material-economic arrangement having to do with practice activities, and the social-political arrangement having to do with relationships prevailing in the practice (Kemmis & Heikkinen, 2011, p. 3; Kemmis & Mutton, 2012; Kemmis & Grootenboer, 2008; Kemmis et al., 2014; Mahon et al., 2017; Kemmis &

Edwards-Groves, 2018). Mahon et al. (2017, p. 10) stressed that practices in a site and their arrangements are “enmeshed”, as opposed to “bundled”, to show how strongly they bond to each other. They further explained that the use of ‘enmeshed’ “recognises the fluidity and volatility with which practices engage with the particularities of arrangements in sites, and also recognises the variation, improvisation, and innovation with which practices are enacted” (*ibid.*). The arrangements or the conditions do not simply enable or constrain a practice but also ‘prefigure’ it, meaning they direct “the flow of activity by qualifying the possible paths it can take” (Schatzki, 2002, p. 44). Schatzki (2002, p. 45) went on to say that what happens now “prefigures forthcoming activity by constraining and enabling it”. Practice architectures refers to these arrangements which make practices “hang together” (Hemmings et al., 2013, p. 474). Practice architectures are the prevailing conditions which model or shape the outcome of a practice. This means that they determine how the practice unfolds, in which case they provide enabling and constraining conditions in the development of a practice. All these ideas are depicted in the following diagram representing the theory of practice architectures.

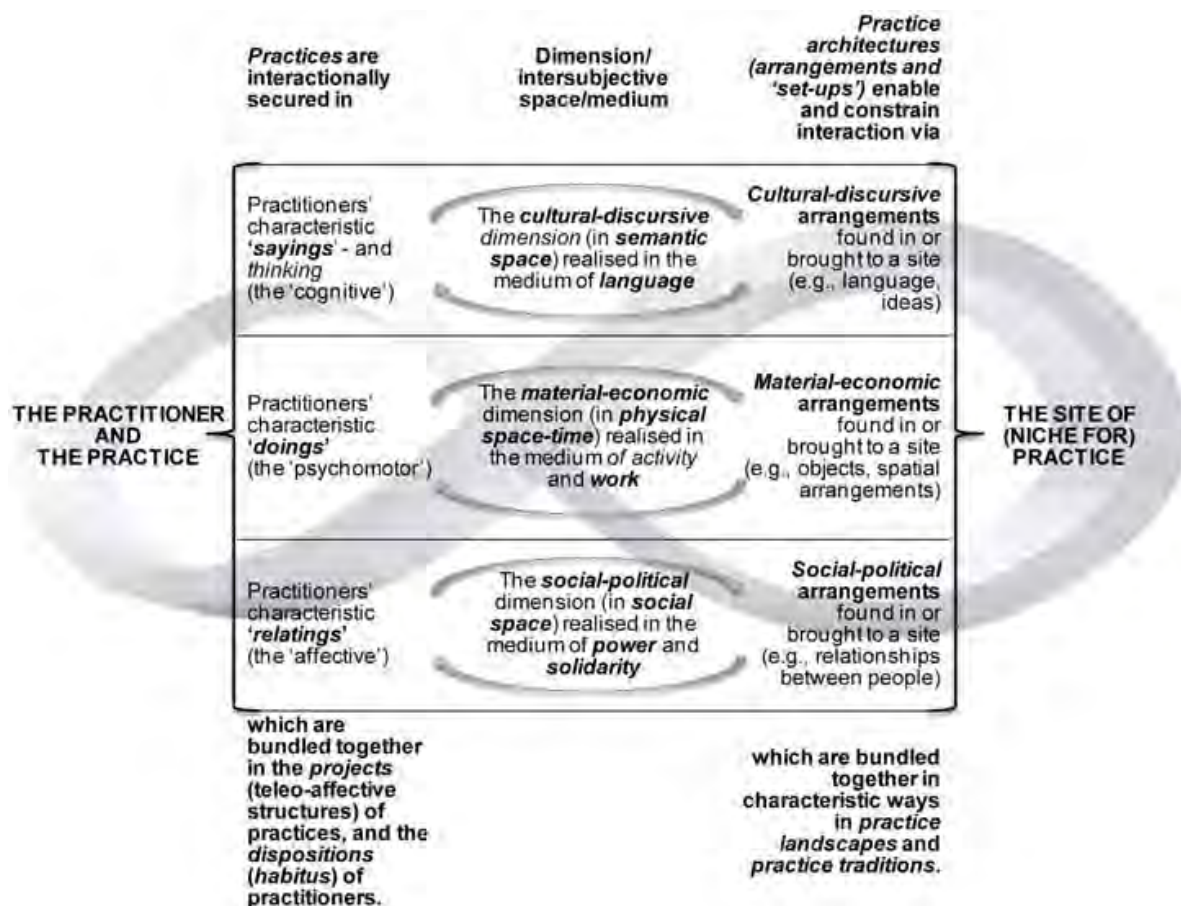


Figure 2.1: Theory of practice architectures

Source: Hemmings et al. (2013, p. 475)

The projects or the teleo-affective structures of the practice are the actual purpose or purposes of the practice, and the dispositions or the habitus of the practitioners are the “knowledge, the skills and values” the practitioners acquire during the development of the practice (Kemmis et al., 2014, p. 38). It is important to note that the practice arrangements do not necessarily make practices immobile, they are in fact changing from time to time and from place to place (Kemmis & Mutton, 2012, p. 194).

2.2.1.1 The semantic space of teaching and learning Biodiversity

The semantic space is a space in which the use of a specific language related to the teaching and learning of Biodiversity is made possible. It is where Biodiversity terms and concepts are discussed and understood. Different Biodiversity concepts and terms are used during the Fundisa for Change training and in the classroom during the process of teaching and learning. The study looks at how the teachers engage with these terms and concepts, and whether teachers acquire any new knowledge; what makes the teachers able or unable to effectively use these terms and concepts, and the language of instruction. Some examples of these terms and concepts as they appear in the CAPS curriculum include Biodiversity, Biomes, Taxonomy, Ecosystems, Human-Environment relationships, Ecosystem Services, Global Warming and Climate Change. Some of these terms and concepts are highly contested, quite complex and contextual, and it is very interesting to find out what ideas teachers hold about them. These constitute the characteristic sayings related to the teaching and learning of Biodiversity.

2.2.1.2 The physical space-time of teaching and learning Biodiversity

This is the space in which it is possible to carry out activities and actions relating to the teaching and learning of Biodiversity. The study looks at the activities teachers are engaged in during their training in the Fundisa for Change programme, what they do and how they do it, what skills they acquire, how they use these skills and how the Fundisa for Change programme supports them. It further looks at the physical set-ups of the training venues which enable or constrain the learning process for the teachers, the availability and physical set-up of furniture in the classrooms, the availability of teaching and learning support materials at schools and the classroom capacity. The element of time is also looked into in terms of how it affects the process of training the teachers and also how it affects teaching and learning in the classroom. The duration of the training workshops, the time allocated to the workshop activities, the timing of the training workshops and the duration of the Biodiversity lessons, are all considered.

2.2.1.3 The social space of teaching and learning Biodiversity

In this space the relationships between trainers and teachers, among the teachers themselves, between the teachers and the learners, among the learners themselves, and between the human and non-human entities in general, are looked at. These relationships are very broad. They include the school and the DBE regulations and policies, and the curriculum itself. The relationships are both formal, meaning that they are realised within the education system, and non-formal, meaning that they also result outside the schools (Kemmis & Heikkinen, 2011, p. 10). An example of a non-formal relationship is the fact that teachers and learners are not only expected to care for the environment when they are at school because this is where they learn about it, but they also have to show this love and care wherever they go and in whatever they do. These relationships or relationships are important as they shape how the teaching and learning of Biodiversity unfolds.

2.2.1.4 Meta-practices

Still in the social space, Kemmis and Heikkinen (2011) talked about the presence of four meta-practices, which are large practices affecting the development of minor practices such as the one in question in this study, which is teacher professional development (p. 10). These meta-practices are: (a) initial and continuing teacher education – which influence the way teachers are trained at the teacher training institutions; (b) politics and administration – which are responsible for curriculum change (the CAPS in this case), resource allocation and infrastructure development at schools and even at teacher training institutions; (c) educational research and evaluation – which help study and evaluate education for better understanding, and (d) student and teacher learning – which influence how teachers teach students and how teachers learn from each other in schools – it is here that the ideas of teacher clusters and professional learning communities became important (Kemmis & Heikkinen, 2011, p. 11). Kemmis et al. (2014, p. 37) included the fifth meta-practice which they called “educational practice” or teaching which has to do with the actual teaching in the classroom. These meta-practices also influence each other.

2.2.2 Ecologies of practices

The concept of ecologies of practices originates from Fritjof Capra’s systems thinking. Capra (1982, p. 286) indicated that “the systems view looks at the world in terms of relationships and integration. Systems are integrated wholes whose properties cannot be reduced to those of smaller units”. He further indicates that the smallest units such as cells, together with tissues

and organs, are also systems as there are complex activities taking place inside them (Capra, 1982, p. 87). Systems thinking also includes the social systems demonstrated by insects, humans, and ecosystems showing relationships between the living and the nonliving (*ibid.*). Capra indicated that the interrelationships between the living systems show certain characteristics which he called “principles of ecology, principles of sustainability, principles of community or ... the basic facts of life” (2005, p. 23). He lists these principles as “networks, nested systems, interdependence, diversity, cycles, flows, development, and dynamic balance” (*ibid.*). A brief description of each of these principles is provided below.

2.2.2.1 Principles of ecology as described by Fritjof Capra

2.2.2.1.1 Networks

Systems are connected to each other such that the function of each system contributes to the overall function of all the systems together. Ecological systems are networked, and it is these network relationships that enable them to support each other to maintain their overall purpose (Capra, 2005, p. 23). In this study, the idea is that teacher training, teacher learning, teaching and assessing Biodiversity as practices are connected to each other. Students cannot effectively learn if the teachers are not adequately trained on how to teach and assess Biodiversity content which the teachers themselves also have to learn. The training should also provide mechanisms to encourage and support teacher learning.

2.2.2.1.2 Nested systems

Some systems are embedded in other systems meaning that smaller systems are included in larger ones. The function and purpose of the smaller system feed into the overall purpose and function of the bigger system. Capra (2005, p. 24) mentioned that systems are multileveled and these levels affect each other, but higher levels have features that are not present in the lower levels. An example of the nested system is a learner being in a classroom which is found in a school, and the school being in a particular educational district found in a provincial education department, which accounts to the national education ministry (*ibid.*). In this study, it was envisaged that the training of teachers will influence the way teachers learn and this will in turn influence the way teachers teach and assess Biodiversity. This means that teaching and assessing of Biodiversity are nested in teacher learning which is in turn nested in teacher training.

2.2.2.1.3 Interdependence

Systems mutually depend on each other. This stresses the fact that systems do not exist in “isolation” (*ibid.*). That is the reason why they are networked. The indication here is that in the context of this study, teacher training, teacher learning, teaching and assessing Biodiversity should depend on each other. What is learnt in the training should inform what teachers are to teach, how to teach and assess it. The knowledgeable teacher should be able to select appropriate teaching and assessment methods to make students learn better.

2.2.2.1.4 Diversity

Different organisms or parts of a system have different roles in an ecosystem in order to maintain it. The importance of having a diverse community is to be able to overcome the problems facing the entire community due to the fact that if one member of the community is affected, some are able to close the gap by playing that role. Capra (2005, p. 25) indicated that

A diverse ecosystem will be resilient because it contains many species with overlapping ecological functions that can replace one another. When a particular species is destroyed by severe disturbance so that a link in the network is broken, a diverse community will be able to survive and reorganize itself because other links can at least partially fulfil the function of the destroyed species.

Applying this idea to the teaching practices could mean that effective teaching of Biodiversity, and assessment, involve the use of different methods to cater for different learner needs. Use of a single teaching method or assessment method may alienate other learners and this might lead to poor learner performance. It is also expected that the Fundisa for Change training should apply different methods such as group-work and fieldwork to cater for different teachers and to expose teachers to these different teaching methods.

2.2.2.1.5 Cycles

Ecosystems are characterised by cyclic movement of matter, as in the case of water cycle (Capra, 2005, p. 25). Some cycles, such as the carbon cycle, involve organisms feeding on each other. In an ecosystem, the waste from one organism is food for another organism (*ibid.*). As teachers are trained they acquire skills and some of these skills might prove to be useful and they might use them in different classes or in the same class but with different groups of learners at the beginning of a school year.

2.2.2.1.6 Flows

The energy, originally captured from the sun by the green plants, flows from one organism to another in an ecosystem, and as it flows some of it is converted to other forms such as heat energy and kinetic energy. As Capra indicates, “All living systems, from organisms through ecosystems, are open systems” (2005, p. 26). This refers to the possibility that the knowledge and the skills the teacher gains from the training are passed onto the learners, and the learners move with these across to the higher grades. This knowledge and the skills could manifest themselves out as improved student learning which might eventually lead to better performance.

2.2.2.1.7 Development

Organisms develop, resulting in the development of the ecosystems. Development is part of the learning process, and as it occurs, organisms or ecosystems go through different developmental stages (Capra, 2005, p. 27). Capra further indicated that the developmental process is not linear, meaning that what we start with cannot always determine the outcome; it is therefore important to be cautious of developmental processes which lead to unknown consequences (*ibid.*). It could be argued that the whole purpose of the training is to professionally develop the teachers. As teachers develop in terms of gaining new content knowledge, learning new teaching and assessment methods, student learning might also improve. Realising this developmental status depends on many other contextual factors which might include availability of teaching and learning materials and how these are used.

2.2.2.1.8 Dynamic balance

The indication here is that in an ecosystem, there is a way in which organisms maintain an ecological balance. This balance is sometimes disturbed, but ecosystems are able to adjust themselves in order to absorb the pressure, the reason why they are regarded as dynamic (Capra, 2005, p. 28). According to Capra (2005):

All ecological cycles act as feedback loops, so that the ecological community continually regulates itself. When one link in an ecological cycle is disturbed, the entire cycle brings the situation back into balance, and since environmental changes and disturbances happen all the time, ecological cycles continually fluctuate.

However, there is a threshold to which ecosystems can withstand disturbances or pressures and if this is surpassed, the balance will collapse, destroying the ecosystem (*ibid.*). Capra (2005)

indicated that all these principles apply to all organisms and social systems, and the intention is to sustain their livelihoods. As he concluded, he said that “Nature demonstrates that sustainable systems are possible” (Capra, 2005, p. 29). This also means that the four practices to be looked at can potentially support each other.

2.2.2.2 Practices as living entities

Kemmis et al. (2014, p. 49) used these Capra’s principles of ecology to determine whether practices could be regarded as ‘living’, and whether their interrelationships, in ecologies of practices, characterise those of living systems, as portrayed by the principles stated above. They provide the following framework for determining the livelihood of practices and ecologies of practices. This is the framework I will use in studying teacher training, teacher learning, teaching Biodiversity and assessment practices in this research.

Table 2.1: Capra’s principles of ecology as criteria for determining whether practices and ecologies of practices are living systems in ecological relationships

Concept	If ecologies of practices are living systems, then
<i>Networks</i>	Different practices would derive their essential properties and their existence from their relationships with other practices.
<i>Nested systems</i>	Different levels and networks of practices would be nested within one another.
<i>Interdependence</i>	The sustainability of different practices (understood as different species of practice, manifested in reality in particular individual instances of that practice) would be dependent on one another in ecologies of practices (understood as an ecosystem), and the sustainability of an ecology of practices would be dependent upon its relationships with other ecologies.
<i>Diversity</i>	An ecology of practices would include many different practices with partially overlapping ecological functions that can partially replace one another.
<i>Cycles</i>	It would be possible to observe some kind of matter cycling through practices – for example, as in a food chain.

<i>Flows</i>	Energy would flow through the ecology of practices and the practices within it, being transformed from one kind of energy to another (in the way that solar energy is converted into chemical energy by photosynthesis) and eventually dissipates (as heat is lost from the bodies of living creatures).
<i>Development</i>	Practices would develop through stages, and an ecology of practices would also develop through stages.
<i>Dynamic balance</i>	An ecology of practices would regulate itself through processes of self-regulation, and would (up to some breaking point) maintain its continuity in relation to internal and outside pressures.

Source: Kemmis et al., 2014, p. 49

The above-mentioned ideas will be used to explain how, if that is the case, the teaching of Biodiversity, teacher training, teacher learning and assessing Biodiversity, could be regarded as ‘living’, relational systems. This will provide answers to Question 4.

While these theories were helpful in understanding and interpreting the real world, there are also limitations associated with using them. Theories are not able “to account for all the nuances and complexities of a dynamic, contradictory world. They are also limited in the sense that they narrow the perspectives of the world being examined” (Mahon, 2014, p. 81). For example, ecological systems may not fully explain human reflexivity in a system. However, as outlined above, they help to foreground more relational processes and dynamics which is at the core of practice theory.

2.3 Environmental Education

This research focuses on four areas: the teachers’ experiences of the Fundisa for Change continuing teacher professional development programme; the influence, if any, of the Fundisa for Change continuing teacher professional development programme on teachers’ practice; the features of Fundisa for Change continuing teacher professional development programme and how these relate to characteristics of effective continuing teacher professional development; and the relationality of practices. With the development of CAPS, teachers need to be supported in order for them to implement it effectively. Bruce and Calhoun (2010) suggested that in this century, teachers need to have more subject content knowledge and how to teach it, and suggest

that “coaching becomes an avenue for modernizing the curriculum” (p. 49). The study also looks at some of the factors involved in professional development of teachers, with the particular focus on environment and sustainability issues. Having learnt from the failures of OBE, the teachers’ experiences of Fundisa for Change continuing teacher professional development programme are investigated, and some of the participating teachers are followed up via interviews to practically document their experiences in relation to their environment and sustainability content knowledge and their practice.

Environmental Education research has shown that some South African teachers lack environment and sustainability content knowledge due to the fact that this content is new (Lotz-Sisitka, 2011, p. 34; Songqwaru, 2012, p. i; and Fundisa for Change Programme, 2013, p. 7). This new content focuses on Climate Change and Biodiversity among other topics. The South African education system is negatively affected by many factors, the most important of which are “teachers’ poor subject matter knowledge and pedagogical content knowledge ...” (South Africa. DBE & DHET, 2011, p. 4).

The idea behind the development of Environmental Education was clearly formulated in 1972 during the United Nations Conference on the Human Environment held in Stockholm, Sweden (UNESCO, 1978, p. 6). The main reason for the development of Environmental Education ideology was to tackle the problems facing the environment, globally, regionally and locally. The 1978 UNESCO Tbilisi report highlighted that Environmental Education can potentially improve the attitudes of people towards the environment as this may play a major role in their caring for and maintaining its quality (p. 6). It further stresses that only those citizens who are knowledgeable about environmental matters can care for, maintain, and prevent further damage to the environment (UNESCO, 1978, p. 6). It is also strongly recommended in the report that Environmental Education should be “... a key component ...” of new educational policies being formulated by the countries of the world (UNESCO, 1978, p. 7). South Africa, as a member of the international community, also takes part in international conferences and hence is bound to adopt the conventions, treaties, protocols and resolutions made at global level (South Africa. Department of Environmental Affairs and Tourism (DEAT), 2005, p. 11). This could be one of the reasons why the environment and sustainability content knowledge has been included in many of the subjects in the new CAPS curriculum.

The plan to formulate Education for Sustainable Development (ESD) first came from the 1987 World Commission on Environment and Development report, and this plan was fostered by a series of meetings and conferences which included the World Conference on Environment and Development held in 1992 in Rio de Janeiro, and then the World Summit on Sustainable Development held in Johannesburg in 2002 (Jickling & Wals, 2008, pp. 3-4). Discussions were held in this series of meetings and conferences with the aim of changing Environmental Education to ESD. National policies in several countries regard ESD as “a new and improved version of environmental education” (Jickling & Wals, 2008, p. 4). ESD is another element of Environmental Education which brings forth the idea that development over a long period of time is realised through the balanced interaction between the society, the economy and the environment (Lotz-Sisitka & Raven, 2004, p. 67). Lotz-Sisitka and Raven (2004) further noted that many countries are changing their curricula and policies to address the problems they are facing and issues of sustainable development (p. 68). South Africa is a good example of such countries as it has just implemented a new curriculum in its schooling system that reflects these concerns. Jickling and Wals (2008) expressed the notion that although there are debates about whether ESD is a new type of education or whether it is already included in Environmental Education, the way teachers and curriculum developers think about ESD affects the way the citizens are educated, and hence their future roles in society (p. 6). This is a call for establishing and strengthening capacity building initiatives for teachers such as Fundisa for Change programme to produce future citizens who are well informed about the environment.

2.3.1 Learning in Environmental Education

According to Jickling and Wals (2008, p. 7), there are two groups of theorists proposing how Environmental Education should be taught: transmissive and transformative ways of teaching. The transmissive type of teaching is effectively a lecture method, where knowledge and skills are simply passed on to the learners. The learners are regarded as having little or no knowledge at all of what is being taught, and as a result the teacher is seen as the main actor in the teaching and learning process. Learners are modelled towards achieving preconceived outcomes. As Jickling and Wals (*ibid.*) indicated, “education leads to an authoritatively created and prescribed destination”.

The other group of theorists considers education as a transformative type of a process. They think of learners as coming into the classroom with different kinds of knowledge about certain phenomena depending on their various cultural backgrounds. They stress that learners learn

best when they construct knowledge together, which means group-interaction is very important. Jickling and Wals (*ibid.*) explained that in transformative education “knowledge is not fixed, cut up in pieces and handed over, but rather (co) created by transacting with prior tacit knowledge, the curriculum, and other learners”.

Reflection and meta-cognition are essential pedagogical aspects of constructing knowledge. It is important for the learners to know if they have learnt anything at the end of a teaching and learning process. Von Glasersfeld (1993, p. 31) advocated that,

Students who work at a problem together have to verbalize how they see the problem and how they propose to solve it. This is one way of generating reflection, which requires awareness of what one is thinking and doing. This, in turn, provides occasions for active abstraction (repeating, writing down, and learning by heart what a teacher says – does none of this).

This means that opportunities for the learners to reflect on their learning should be provided and varied to cater for different learners. The most important factor at the beginning of an Environmental Education lesson is to expose learners’ world-views to environmental concepts. It has been emphasised that learners come into the classroom with many different ideas about certain phenomena and in most cases these ideas are greatly influenced by their social or cultural backgrounds. These ideas are commonly referred to as alternative conceptions (Kao, 2007, p. 518). It is therefore very important for a teacher to work with learners’ prior knowledge about a particular concept at the beginning of the lesson to be able to direct the process of teaching and learning appropriately. Watson (2001) supported this notion saying “constructivist teachers allow student responses to drive lessons, shift instructional strategies and alter content” (p. 141). Then outdoor and group work activities can stimulate critical thinking and address these alternative world-views. While some concepts are difficult for learners to grasp, taking them out into the field to learn and experience nature is in most cases better than talking only in the classroom. In this case transformative teaching is the recommended type of teaching.

Some teaching methods, particularly outdoor hands-on activities, are greatly enjoyed by learners and they stimulate an interest in learning while at the same time making learners experience and connect with nature (Rochford, 2005). With this kind of exposure one would expect to enhance participation in learning actions that can contribute to responsible

citizenship. Ashwell (2010) carried out a mixed method research study involving high school youth in Grades 10-12 and some organisations providing nature-based programmes to these youth in Cape Town. The study investigated “the value to adolescents in Cape Town of nature in general and nature-based environmental education – and youth development programmes” (Ashwell, 2010, p. 79). Ashwell (2010) found that outdoor activities were enjoyed by the youth and these improved their friendships, thereby “contributed to their motivation to learn about nature” (p. 177). Field visits or outdoor activities are important because this is where learners have real life experience of what they have been learning in class. Rochford (2005) carried out field trips with postgraduate student teachers at the University of Cape Town for over 20 years (p. 3). After each field trip he asked the student teachers to write a report about the field trip. The following themes were regarded as important aspects of field trips by these student teachers, as reported by Rochford (2005, pp. 3-7).

- 1) Holistic education – During the fieldwork camp students realised that in real life different subjects are not divided up.
- 2) Experimental discovery – Outdoor fieldwork allowed for natural-type learning that benefited formal learning.
- 3) Personal development
- 4) Social learning – Students discovered that knowledge is socially constructed and therefore it is beneficial if they learn together.
- 5) Aesthetic development
- 6) Concept development – Fieldwork allowed development of an overarching understanding of various concepts.
- 7) Skills development – Students received opportunities to develop various skills, e.g. collecting scientific data, recording, observing and analysing, as specified in the Revised National Curriculum Statement: Natural Sciences (2002).
- 8) Attitudes and values – Fieldwork helped to instill feelings of appreciation, astonishment, empathy, care and concern.
- 9) Enjoyment – An outdoor field camp can make serious learning tasks pleasurable.
- 10) Physical development – The camp allowed freedom of movement and the development of physical skills.
- 11) Contextual perspective – Fieldwork provided a context in which students could see the relevance to what they were learning.

2.3.2 Possible reasons for the inclusion of Environmental Education in CAPS

What is so important about the environment and sustainability content that it was included in the new curriculum? Shava and Songqwaru (2017, p. 205) suggested that global environmental concerns were the motive. Berkes, Colding and Folke (2003) indicated that “many of the changes in the biosphere, including the modification of landscapes, loss of biodiversity and, according to some, climate change, are driven by human activities” (p. 1). People need to have knowledge and skills to try to address social problems they are facing due to the negative impact they are currently having on the environment. Scientists are working very hard “to understand environmental issues better and come up with possible solutions and alternative practices” (Fundisa for Change, 2013, p. 7). Education is a very important tool that is used to develop knowledge and skills amongst people so that whatever decisions they make are well informed. Without informed knowledge combined with other structural changes, people may continue to kill wild animals, over-harvest medicinal plants, burn fossil fuels uncontrollably, pollute the environment, clear forests for settlements or agriculture, and use natural resources unwisely. O’Donoghue, Lotz-Sisitka, Asafo-Adjei, Kota and Hanisi (2006) stressed that “learning can strengthen social relationships across school and community and has the potential to develop as reflective praxis in response to environment and health risks in a local context” (p. 435).

Several important policy documents highlight the socio-ecological problems South Africa is facing and the need to develop strategies for dealing with them (South Africa. DEAT, 2005; South Africa. DEAT, 2010; South Africa. DBE & DHET, 2011; and South Africa. National Planning Commission [NPC], 2012). Act 108 of 1996, promulgating the South African Constitution makes provision for citizens to have a clean environment that promotes health and requires all governmental departments to have environmental policies that take into consideration issues of sustainable development (South Africa. DEAT, 2005, p. 11).

Jarvis (2000) suggested that gaining more knowledge through learning “is a reaction to risk, of not always knowing how to act in a rapidly changing world” (p. 350). As Lotz-Sisitka (2009) stressed, environment and sustainability content is important in that it helps society to deal with environmental problems they are facing due to climate change and the loss of biodiversity (p. 173). Millennium Ecosystem Assessment researchers (UN) have suggested that,

The well-being of present and future human populations depends on ecologically sustainable and socially equitable ways of living in the world. In determining how to achieve these, value judgements have to be made concerning equity and ecosystem stewardship. These are the spheres of policy-makers. (Millennium Ecosystem Assessment, 2003, pp. 83-84)

Knowledge can help society to become more resilient to these environmental problems (*ibid.*). Resilience is the ability to withstand or to recover from stress (Swedish Environmental Advisory Council, n.d.). Stress includes all socio-ecological problems such as storms, fire, pollution, poverty, diseases, political and economic instability (Swedish Environmental Advisory Council, n.d.). All these ideas, which are about the environment and the problems associated with it, form part of what is known as Environmental Education.¹

Environmental Education is a form of education which informs people about the environmental problems they are facing today and how they can go about solving them (Kemmis & Mutton, 2012, p. 188). Sustainability, an important aspect of Environmental Education, implies people must use their resources so they last for a long time, and the generations coming after them can still be able to use these resources. The United Nations, at its General Assembly in 2002, made a resolution to observe a period of ten years, from 2005 to 2014, during which member countries were to sensitise and educate their citizens about sustainable living “through different forms of education, public awareness and training activities” (Wals, 2014, p. 8). This period was called United Nations Decade of Education for Sustainable Development (UNDESD). Berkes et al. (2003), drawing on the famous Brundtland Report of 1987, defined sustainability as “the use of environment and resources to meet the needs of the present without compromising the ability of future generations to meet their own needs” (p. 2). The UNDESD embraced Environmental Education as a key aspect of ESD, thus many countries have included it in their educational policies and curricula (United Nations Education, Scientific, and Cultural Organisation [UNESCO], 2014, p. 30). Some of the key findings at the end of UNDESD include: education plays a role in tackling sustainability challenges; collaboration between different sectors of the society, an example of which is Fundisa for Change network, is very

¹ In Southern Africa, Environmental Education is used interchangeably with Education for Sustainable Development as Environmental Education here is also connected to Sustainable Development (Lotz-Sisitka, 2011).

important in Environmental Education; learner-centred approaches are important in Environmental Education; and different countries are introducing Environmental Education into their education systems (UNESCO, 2014). However, some of the challenges which need to be addressed going forward include “the need for more work towards institutionalising ESD to ensure strong political support for implementing ESD on a systemic level; and ... the need for more research, innovation monitoring and evaluation to develop and prove the effectiveness of ESD good practices” (*ibid.*). The Fundisa for Change network has worked towards tackling some of these challenges as strategies have been incorporated in its objectives to address them (refer to Appendix Q). The Global Action Programme (GAP) on ESD was established and launched in November 2014 in Aichi-Nagoya, Japan, in an effort to continue the work that was done during the ten-year period of UNDESD, and to improve ESD efforts in all areas relating to education and sustainable development (UNESCO, 2018). The GAP hoped to do its work by focusing on the five priority action areas which are “1) Advancing policy; 2) Transforming learning and training environments; 3) Building capacities of educators and trainers; 4) Empowering and mobilising youth; and 5) Accelerating sustainable solutions at local level” (*ibid.*), of which this study addresses action area 3.

Following the end of the period dedicated for the achievement of the Millennium Development Goals in 2015, Sustainable Development Goals were formulated and a new time frame of 15 years was developed to carry on the work done in the 15-year period of the Millennium Development Goals with an aim to achieve these goals by 2030. The Sustainable Development Goal which focuses on Environmental Education is Goal 4, which seeks to “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” (UNESCO, n.d., p. 19), through target 4.7 which says that “By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles” (*ibid.*).

Environmental sustainability also advocates the use of renewable energy sources as it has been shown that non-renewable energy sources are diminishing. They will eventually be exhausted, and they are also causing environmental problems such as pollution. These environmental problems pose a risk to society and to the environment itself. The National Environmental Management Biodiversity Act (10/2004) of South Africa serves as a point of reference or a guiding principle in terms of how to conserve and to manage biodiversity in South Africa (South Africa. DEAT, 2005). As outlined in the South Africa’s National Biodiversity Strategy

and Action Plan, people are able to live healthily and peacefully together through the wise use of their resources so that these resources can last longer, and the generations that come after them can still use them (South Africa. DEAT, 2005, p. 13). It is indicated that humans have negatively impacted on the ecosystems through habitat destruction, introduction of alien species and contributing to climate change (South Africa. DEAT, 2005, p. 22). The South African government has developed a National Development Plan in which targets have been set to be achieved by the year 2030. The plan acknowledges the effects of climate change in South Africa caused by the release of greenhouse gases into the atmosphere and a commitment is made to have a clean environment by 2030 (South Africa. NPC, 2012). These are some of the reasons why South Africa is incorporating Environmental Education into their curriculum. A well established goal of Environmental Education, as originally stated in the Belgrade Charter, is:

To develop a world population that is aware of, and concerned about, environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively towards solutions of current problems and prevention of new ones. (UNESCO-United Nations Environment Programme [UNESCO-UNEP], 1976, p. 3)

Teachers play a major role in educating society about the environment. It is therefore important to support them to engage with current environmental knowledge and pedagogical skills on how to teach and assess it. In the curriculum context, this may also result in more effective implementation of the CAPS curriculum, particularly the environmental sections. This is one of the reasons teachers are involved in professional development initiatives such as the Fundisa for Change programme.

2.4 Teacher professional development

The South African Council of Educators (SACE) (2013), whose legal mandate it is to deal with all matters relating to the teaching profession, has indicated that:

Like all professionals, teachers need to grow their knowledge and skills throughout their careers. Like all professions, teaching requires deep knowledge which is continuously updated and widened, and it involves complex skills that need to be continually adapted to new circumstances. (p. 4)

Teacher professional development is a process of equipping teachers with skills and knowledge to improve their practice in order to cope with the changing world, and sometimes, as in the case of South Africa now, to keep up with the changing curriculum. Teacher professional development is aimed at improving teachers' practice by addressing the challenges teachers are facing in their classrooms when it comes to curriculum implementation. Schlager and Fusco (2004) described teacher professional development as "a process of learning how to put knowledge into practice through engagement in practice within a community of practitioners" (p. 124). Lassonde and Israel (2010) defined professional development in more general terms as "participation in opportunities that result in the acquisition of new knowledge, understandings, skills, or strategies that enhance and build upon our current knowledge" (p. 6). This is necessary as knowledge is changing with time (as indicated previously), and thus teachers, as mediators of knowledge, need to be broadly aware of what is happening in the world around them. After all, the whole aim of teacher professional development is to improve the performance of the students (Steyn & van Niekerk, 2005, p. 128). Mitchell (2013) and Mokhele (2013) referred to a type of teacher professional development that takes place after the teacher has completed his or her formal initial training, as continuing teacher professional development. Stevenson, as cited by Mitchell (2013, p. 388), defined continuing teacher professional development as "the continuation of a teacher's professional development beyond their initial training, qualification, and induction". The DBE hoped to form the National Institute for Curriculum and Professional Development (NICPD) whose mandate will be to identify and address training and developmental needs of teachers (South Africa. DBE & DHET, 2011, p. 4), but this is yet to occur. A series of activities are planned for this, which include accrediting short courses provided by certain organisations or institutions to develop teachers, teachers being awarded points when they have completed such courses, and assisting teachers in forming professional learning communities (South Africa. DBE & DHET, 2011, p. 8). Unfortunately, progress has been slow in effecting this goal.

2.4.1 Examples of teacher professional development studies

Lessing and de Witt (2007, p. 56) in their quantitative study which involved 95 teachers from Foundation Phase to Senior Phase, reveal that continuous teacher professional development is important if it: is ongoing; provides teachers with subject content knowledge, pedagogical and assessment skills; stimulates positive attitude and encourages sharing of knowledge and skills; and supports establishment of communities of practice. This study, which took the form of a

survey, was carried out in the Gauteng Province in South Africa. Its purpose was to explore teachers' perceptions on the value of continuous professional development.

Bantwini (2012, pp. 521-522) carried out a study to determine primary science teachers' perceptions of their own professional development organised by the District Department of Education in one region in the Eastern Cape Province. This study consisted of fourteen teachers who were interviewed, selected from 88 questionnaires received. These were Grade 1 to 6 teachers most of whom were professionally trained during the apartheid era. These teachers indicated that they wanted to engage in professional development initiatives for improving their teaching practice. They also mentioned the importance of being provided with subject content knowledge and teaching and learning materials which the Department of Education was failing to provide at that time. The element of time was also highlighted to indicate that more time is required to assimilate the information received during the training or workshops. The teachers stressed that professional development initiatives are fruitful if they address their classroom challenges and provide ongoing support. The two studies mentioned above give an indication of what aspects teachers prefer in a teacher professional development initiative.

A Lesson Study initiative is another form of a continuing teacher professional development process, widely practised in Japan, during which teachers plan a lesson together, then assign one teacher in their group to teach it while other teachers observe, after which they meet as a group to evaluate the lesson for the purpose of improving it. As Cerbin and Kopp (2006) have indicated, "in a lesson study, a small group of instructors jointly designs, teaches, studies and refines a single class lesson called a research lesson" (p. 250). They went on to indicate that "teachers, who may be virtual novices or seasoned experts, share their previous experiences teaching the topic, and discuss possible ways to address the lesson goals" (p. 251). Saito (2012) stressed that post-observation discussions are not necessarily meant to evaluate the teacher who presented the lesson, but rather to teach the whole group during those discussions (p. 783). Ono and Ferreira (2010) remarked that "lesson study is a professional development activity that is characterised as classroom-situated, context-based, learner-focused, improvement-oriented and teacher-owned. It is also collaborative" (p. 64). These characteristics are important as they will be used for reflecting on what will emerge from this study.

The Lesson Study initiative was first implemented in South Africa in Mpumalanga from 1999 to 2006. The project was called Mpumalanga Secondary Science Initiative (MSSI) (Ono &

Ferreira, 2010, p. 65), to help teachers cope with the demands of the then newly formulated Curriculum 2005.² This was necessary as there were not enough qualified Maths and Science teachers as a result of poor teacher training during the apartheid era (Ono & Ferreira, 2010, p. 65). Although the initiative was found to have positively impacted on teaching practices, it was only effective in 15% of the schools that were taking part, and this failure rate was blamed on the partner institutions (Mpumalanga Department Education, University of Pretoria and Japan International Cooperation Agency) which were affected by policy changes and “structural reorganisations” (Ono & Ferreira, 2010, p. 68). The initiative continued to be supported by the Japanese government from 2006 to 2008, even though it was formally terminated in 2006.

Lipowski et al. (2011) in their qualitative study involving six European countries and a total of 14 ‘expert’ participants who were telephonically interviewed, revealed the duration of the training and the “collective participation” to be very important (p. 695). These participants had extensive knowledge and experience in the area of teacher professional development in the European context. They came from Denmark, Norway, Hungary, Germany and the United Kingdom. These responses are also important for reflecting on the results of this study.

Steyn and van Niekerk (2005, p. 133) have provided a comprehensive account of factors affecting the effectiveness and implementation of continuing teacher professional development initiatives. These are shown in the diagram that follows.

² The development and introduction of Curriculum 2005 and CAPS curriculum were explained in sections 1.2 and 2.6 respectively.

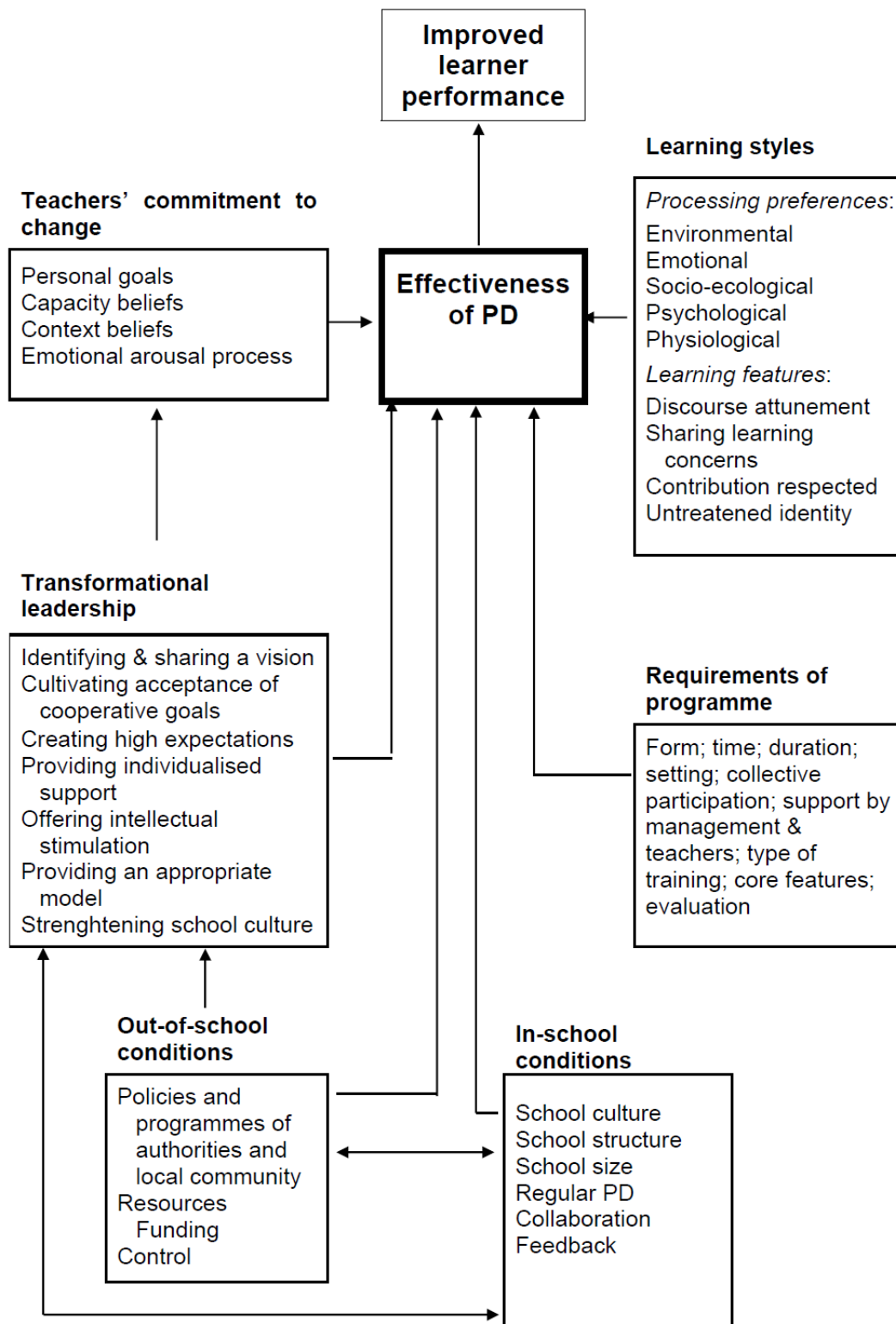


Figure 2.2: Factors affecting continuing teacher professional development initiatives (PD = Professional Development)

Source: Steyn and van Niekerk (2005, p. 132)

2.4.2 Characteristics of effective continuing teacher professional development initiatives

The studies highlighted above give an indication of what teachers and experts say about teacher professional development initiatives that are effective and tailored towards addressing the challenges they are facing. These essential elements of a continuing teacher professional development programme include duration, subject content knowledge, active learning, allowing establishment of professional learning communities, follow-up sessions, assessment and addressing classroom challenges. This, however, is not an exhaustive list of the characteristics, but it is what is commonly talked about in the literature. Steyn and van Niekerk (2005) highlight what they call “critical success factors” in teacher professional development as: being longer, more content focused and encouraging active learning; encouraging communities of practice to share the same values and goals; getting support from the entire school community; and being linked to the curriculum (p. 142). Mokhele (2013) referred to these characteristics as “Key features of successful continuous professional development programme” (p. 74). Archibald, Coggshall, Croft and Goe (2011, p. 3), having searched through the literature, came up with what they called “high quality” features of a teacher professional development programme liked by many teachers. These are:

1. Alignment with school goals, state and district standards and assessments, and other professional learning activities including formative teacher evaluation,
2. Focus on core content and modeling of teaching strategies for the content,
3. Inclusion of opportunities for active learning of new teaching strategies,
4. Provision of opportunities for collaboration among teachers,
5. Inclusion of embedded follow-up and continuous feedback .

Key characteristic features of effective continuing teacher professional development initiatives commonly spoken about in the literature are explained below (as adapted from Steyn & van Niekerk, 2005; Desimone, 2009; Archibald et al., 2011; Mokhele, 2013, and contextualised). These characteristic features are: duration, subject content knowledge, teacher engagement, collaboration, follow-up, assessment and coherence.

2.4.2.1 Duration

Time is a very important factor in continuing teacher professional development processes. Teacher trainings that are of short duration – several hours or a day – have been found to be ineffective. Desimone (2009) indicated that acquiring knowledge and new teaching skills requires a longer time, which is usually “20 hours or more of contact time” (p. 184). The reason

behind this is the fact that normally a lot of information is disseminated to teachers within this time and it is difficult for them to grasp it within a short period. It is therefore imperative that continuing teacher professional development initiatives be run over a longer period to give teachers time to do the activities and to digest the information gained. The time of the year, month, week or even the day plays a major role in affecting teachers' willingness to participate in a training workshop. There are times when teachers are busy with assessing learners, which is normally the last month of each term, and they do not want to be disturbed during this period as they work under pressure to complete and mark the assessment tasks to issue out report cards for the learners. Some teachers do not like to attend training workshops during the holidays, weekends or after working hours as they feel that this is the time for them to attend to personal matters. Lessing and de Witt (2007) indicated that they held training workshops for Maths and Language teachers for six Saturdays, and the trainee teachers complained of having "sacrificed" a lot of their time attending the training during the weekends.

2.4.2.2 Subject content knowledge

Subject content knowledge is highlighted as one of the major challenges facing teachers, particularly when it comes to the introduction of new topics in the curriculum due to curriculum change. Ramnarain and Fortus (2013) indicated that in some other countries, research has shown that teachers face difficulties implementing new curricula when new topics have been introduced because of lack of confidence in their subject content knowledge (p. 1). This is particularly important in the South African context due to the lack of environmental content knowledge in some teachers (mentioned earlier). Mechanisms have to be put in place in teacher professional development programmes to help teachers gain more subject content knowledge. The subject content knowledge as highlighted by Ramnarain and Fortus (*ibid.*) improves teachers' levels of confidence when it comes to teaching, and this confidence can allow the lesson to progress smoothly as the teacher is in a position to choose appropriate teaching methods and also answer learners' questions. It is not only the subject content knowledge that is of importance: the knowledge of how this subject content knowledge is mediated is also of great importance.

2.4.2.3 Teacher engagement/active learning and participation

The knowledge that the learner (meaning the person gaining knowledge) has is greatly influenced by the society or the community to which that particular learner belongs. People live as members of different communities and the way they see and make sense of the world

will be different. Each society has its own language, belief systems and ways of doing things, and these are passed from generation to generation. Teachers come to the training with their own knowledge and belief systems about the environment and sustainability concepts, and during the training they will be constructing new knowledge about these aspects. Gawe, Vakalisa and van Niekerk (2000) added that “knowledge is a construction of the learner (knower), and it is subject to the social milieu within which the learner is located. Knowledge ... is acquired through interactive and dialogical engagement with what is to be learnt” (p. 162).

The multiplicity of knowledge claims and understanding about the same concepts might create confusion as people understand the same concept differently and whose knowledge is to be agreed upon might be a problem. This is the challenge in the implementation of Environmental Education in CAPS in that it is a new field with a new kind of knowledge to some teachers. These teachers might not have learnt about the environmental concepts mentioned in CAPS during their training, which means that they have their own cultural knowledge about those particular concepts, or they might have read about them and then developed their own understanding. This is the reason why teacher training programmes such as Fundisa for Change are important in providing teachers with standardised and current knowledge on these environmental concepts. Up-to-date knowledge is crucial in Environmental Education as it changes from time to time and may also be contentious.

Active learning allows dialogue. This means teachers are given a platform to work together in discussion groups in which they are able to voice whatever ideas and knowledge they may have about environmental concepts. With open discussions where claims are made and substantiated and sometimes rebutted, teachers might come to the realisation that they might have to reconstruct their ideas about those concepts. What is important is that teachers are not simply told about the new concepts, they are involved in intense discussions with their colleagues and this allows deep introspection in terms of their existing knowledge. This might eventually lead them to internalising the new knowledge as it is mediated. Themane and Mamabolo (n.d.) regarded “knowledge as a social construct and therefore curriculum as a social contextual process” (p. 2). They went on to indicate that teachers must critically analyse the new knowledge that they are acquiring to fully understand it, and they should, if necessary, also be prepared to let go of the old concepts that they learnt during their initial training at the teacher training institutions (Themane & Mamabolo, n.d., p. 2). Desimone (2009) indicated that

“opportunities for teachers to engage in active learning are also related to the effectiveness of professional development” (p. 184).

2.4.2.4 Collaboration or promotion of communities of practice

A community of practice can be regarded as a group of people having the same vision and working together to achieve a certain goal, while at the same time becoming more knowledgeable and skilled in their area of interest (Wenger, McDermott, & Snyder, 2002, p. 4). Different people, having formed such different groups, make what are called communities of practice. These groups include a wide range of interests, from church groups to professional bodies. Wenger (1998) indicated that “We all belong to communities of practice. At home, at work, at school, in our hobbies – we belong to several communities of practice at any given time” (p. 6).

Many terms are used to describe groups of teachers working together for a purpose. These include “teacher professional communities, professional learning communities, communities of practice, teacher learning communities and networked communities” (Younger & George, 2013, p. 312). Younger and George (2013) further proposed the use of “community of practice as an umbrella term” to describe a group that is formed voluntarily and that has a common purpose (p. 314). They therefore define communities of practice as “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly, working collaboratively to examine and reflect on practice” (Younger & George, 2013, p. 314). Desimone (2009) indicated that teachers can work collaboratively together in a school at subject, departmental or even school level, and this can be a very important way of learning (p. 184). Teachers from different schools and Educational Districts can also work collaboratively. The DBE hopes to assist teachers in establishing professional learning communities so that teachers can have ongoing collaboration with each other. Some of the activities teachers will be involved in include: sharing of best practices in terms of CAPS delivery, scrutinising learning support materials to see if they are in line with CAPS requirements, and interpretation of CAPS (South Africa. DBE & DHET, 2011, p. 14). These professional learning communities are regarded as

... communities that provide the setting and necessary support for groups of classroom teachers, school managers and subject advisors to participate collectively in determining their own developmental trajectories, and to set up activities that will drive their development. (South Africa. DBE & DHET, 2011, p. 14)

The Fundisa for Change network is also regarded as a community of practice in which a wide range of practitioners such as teachers, subject advisors, lecturers, botanists, zoologists, hydrologists and climatologists come together to share their knowledge and experiences for improving the quality of education (Fundisa for Change Programme, 2015, p. 3). The Fundisa for Change programme took part in the DBE professional learning communities colloquium organised by DBE at its head offices in Pretoria on 18 September 2014 during which the programme coordinator “presented how Fundisa for Change supports and strengthens teacher and subject advisor professional learning communities nationally” (*ibid.*).

2.4.2.5 Follow-up

Teachers might attend the same training run by the same trainers, but the context in which they work differs from teacher to teacher. Some of these contextual factors create challenges when it comes to implementing the ideas acquired from the training. It is therefore helpful to follow up with teachers to find out how they cope. The follow-up could take the form of school visits or correspondence through phone calls or emails. Steyn (2011) asserted that effective professional development of teachers “is a continuous process that involves appropriately planned development and follow-up through supportive feedback and observation, staff dialogue and peer coaching” (p. 44). Follow-ups with teachers might make them feel they are being taken seriously and give them a sense of belonging. However, these must be carried out with caution, as it has been mentioned earlier that some teachers are reluctant to be visited, especially if the follow-ups involve classroom visits. The follow-up can also help teachers establish professional learning communities and then provide continuous support.

2.4.2.6 Assessment

Assessment is also an important aspect of a continuing teacher professional development initiative as it makes teachers view their training seriously, and not as something that wastes their time. Assessment should test the ability of a teacher to apply ideas and skills acquired. Steyn (2011) expressed the notion that the professional development of teachers needs to be monitored and teachers need to be informed of their ability to use the knowledge and the skills gained from the training workshops (p. 45). In the case of South Africa, accredited continuing teacher professional development programmes must include some form of assessment for teachers, and teachers are awarded points after successfully completing the assessment tasks. It is a new requirement for all teachers in South Africa that they engage in professional development activities that earn at least 150 points within a three-year cycle (SACE, 2013, p. 5).

2.4.2.7 Coherence

This simply refers to the notion that teacher professional development initiatives should be in line with the training needs, the goals and objectives of the school, the Department of Education policies and the policies of the country as a whole (Desimone, 2009, p. 184). These initiatives are meant to address common issues that teachers face so that they do not feel isolated. During the process of curriculum change, development and implementation, different sectors of the society interested in education, for example teacher trainers and textbook developers, might have different interpretations of the curriculum with regard to what knowledge is represented, how it is represented and how best to teach it. It is for this reason that Archibald et al. (2011) noted that “teachers who receive consistent messages regarding what to teach and the best ways to teach it are most likely to improve in their practice” (p. 3).

In concluding a discussion on characteristics of effective continuing teacher professional development initiatives using the categories applied to this section, Desimone (2009, p. 185) proposed a model for studying these characteristic features, which she called “core features”. What this model illustrates is that a teacher professional initiative that is characterised by these features improves teachers’ skills, knowledge and attitudes which improve teachers’ practice, and that this leads to an improvement in learner performance. The model is shown below.

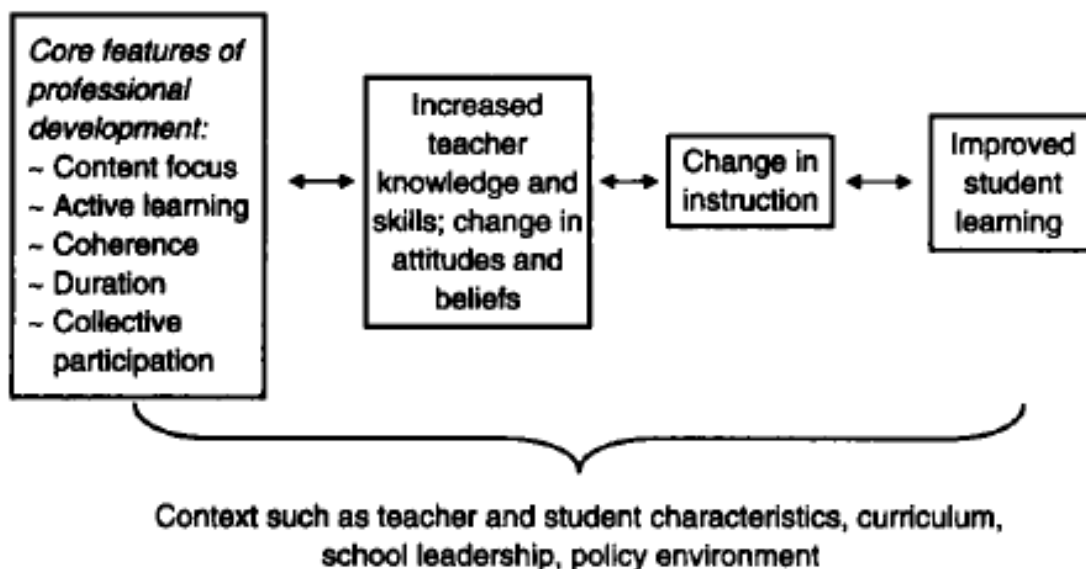


Figure 2.3: Proposed core conceptual framework for studying the effects of professional development on teachers and students

Source: Desimone (2009, p. 185)

The section that follows describes the importance of classroom-based research and why teachers are encouraged to participate in research to evaluate and improve their teaching practice.

2.5 Classroom-based research

Hopkins (1993) simply referred to classroom research as what teachers do “to enhance their own or a colleague’s teaching, to test the assumptions of educational theory in practice, or as a means of evaluating and implementing whole school priorities” (p. 1). From this point, classroom research is carried out with the aim of improving the process of teaching and learning in the classroom as it allows reflection and reflexivity on the part of the teacher, who acts as a practitioner. It is in this light that the role of other teachers and interested parties is of utmost importance in observing and recording classroom interactions for constructive feedback. Hopkins (*ibid.*) further noted that when teachers do research on their own practice or on other teachers’ practice, they develop a sense of “increased responsibility for their actions and create a more energetic and dynamic environment in which teaching and learning can occur”.

Teachers, through working with others, constructively reflect on their own practice or on each other’s practice for improvement, as a result of which they grow professionally and are able to implement the curriculum better and hence improve the performance of their learners. The idea of a teacher being a researcher in his or her classroom is a very important aspect of the teaching and learning process as it allows the teacher

... to think systematically and critically about what he or she is doing and to collaborate with other teachers. Central to this activity is the systematic reflection on one’s classroom experience, to understand it and to create meaning out of that understanding. (Hopkins, 1993, p. 7)

Classroom research in the form of lesson observation is carried out by many researchers and has different foci, for example, assessment, language use, teaching styles, classroom discipline or the use of teaching and learning support materials. Barocsi (2007) however stipulates that lesson observation should be carefully planned and discussed with the teacher so that it does not end up being regarded as a fault-finding mission on the participant teacher; rather it should be seen as a professional development initiative meant for the teacher to improve his or her practice (p. 129).

This is one of the challenges I faced in the present study as explained in section 3.8. I had wanted to visit the teachers in their classrooms to observe and document their practice, but all the attempts I made were unsuccessful. Teachers may have been busy administering assessment tasks for the end of the third term, but there should have been an opportunity for classroom observations as they were still busy with the environmental aspect of the curriculum, particularly in Grade 11. In fact when one of the teachers was contacted about the classroom visit, he confided that he had not even begun teaching the section. There are other factors which could contribute to this reluctance. One factor could be the legacy of apartheid, where the people who frequently visited the schools were the school inspectors who were normally coming to police teachers to make sure that they delivered the apartheid curriculum correctly, and some of the teachers in schools today were either students then or even teachers themselves. Beets (2012) explained that “segregated Black public schools were required by law to teach a curriculum that sought to cultivate a sense of inferiority in teachers and learners” (p. 10).

Another factor could be attributed to the lack of understanding from the teachers on the ethical obligation of the researchers. Some teachers think that researchers are there to judge them in terms of their content knowledge and perhaps how they teach. This is in line with what Arzi and White (2007, p. 222) have found working with some Australian teachers over a 17-year period: that it is difficult to work with practising teachers in research as participants because they sometimes think that questioning them amounts to testing their professional status and this might make them feel disrespected. Barocsi (2007), however, expressed the notion that even though classroom observation “may cause conscious or subconscious frustration and pressure” on the observed teacher, it is a very important tool for data collection and understanding what happens in the classroom.

Lack of confidence in teaching the new content in the presence of a stranger (in this case the researcher), might contribute to some teachers being reluctant to be observed. Inadequate content knowledge in some teachers results in them not teaching certain topics properly, leading to learners not understanding the content (South Africa. DBE, 2014, p. 5). Classroom research can inform policy makers of what really happens in the classroom and this may result in curriculum policy changes as is the case in South Africa now. The next section describes the reasons behind CAPS formulation and how it was implemented.

2.6 CAPS formulation and implementation

CAPS was formulated out of the recommendations from the Ministerial Task Team report presented to the Minister of Basic Education, Mrs Angie Motshekga, in October 2009 (South Africa. DBE [Curriculum News], 2011, p. 3), in response to the complaints originating from different sectors of society about the OBE curriculum. The RNCS Grades R-9 of 2002 and NCS Grades 10-12 of 2003 and 2005 were then revised and replaced by NCS Grades R-12 of January 2012 (South Africa. DBE, 2011, p. 3). The timeline that follows shows how the South African school curriculum changed and was revised after 1994.

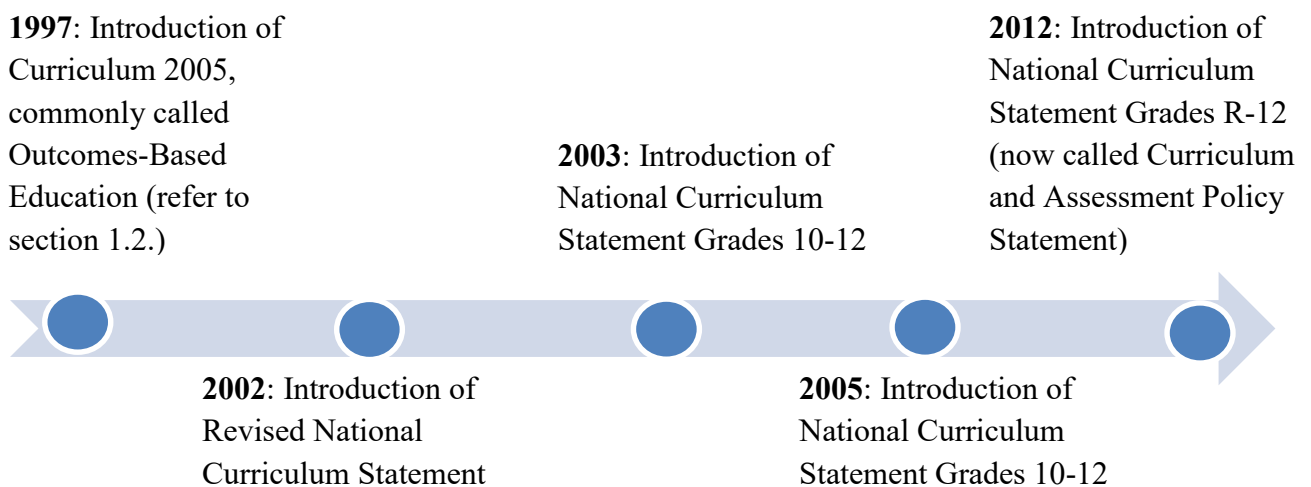


Figure 2.4: South African Education curriculum development post-1994

The Curriculum and Assessment Policy Statement (CAPS) was then developed and implemented in phases, starting with Grades R to 3 and Grade 10 in 2012, Grades 4 to 9 and Grade 11 in 2013, and Grade 12 in 2014 (South Africa. DBE [Curriculum News], 2011, p. 4). CAPS has three main focus areas: subject content knowledge, teaching methods and assessment methods. Subject content knowledge is the information or topics that have to be covered by the teachers and learners; the teaching methods represent the ways in which this information is passed on to the learners, while the assessment methods are the ways of testing learners to see whether the goals and objectives of the lesson, the topic or the curriculum have been achieved. This means that each subject being taught has its own CAPS indicating what content has to be covered, how it has to be taught and how it has to be assessed.

In all CAPS documents, the principles enshrined in the constitution of the country are emphasised. These are meant to continue addressing the legacy of the apartheid injustices. These principles, as spelt out by the DBE (2011, pp. 4-5), are as follows:

1. 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;
2. Active and critical learning: encouraging an active and critical approach to learning, rather than rote and uncritical learning of given truths;
3. 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;
4. Progression: content and context of each grade shows progression from simple to complex;
5. 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. The National Curriculum Statement Grades R-12 is sensitive to issues such as poverty, inequality, race, gender, language, age, disability and other factors;
6. 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
7. Credibility, quality and efficiency: providing an education that is comparable in quality, breadth and depth to those of other countries.

It has been indicated earlier that in many of the subjects in the new curriculum, environment and sustainability content has been explicitly included. However, it is clear in the fifth principle above that in all the subjects, issues relating to the environment and sustainability have to be expressed, either explicitly or implicitly. These principles also give an indication of what kind of teachers we need to have at schools: highly knowledgeable teachers in terms of subject content who are able to provide quality education to the future drivers of the country's economy; and highly skilled teachers in terms of teaching and assessment methodologies who are able to produce learners who are critical thinkers and are able to apply knowledge in different complex contexts to solve problems. This calls for more teacher engagement in professional development initiatives. Kang, Cha and Ha (2013, p. 11) asserted that effective continuing teacher professional development programmes are of importance because they can positively impact on teachers' practice and on the learning process both for the teachers and

the students. The section that follows explains how the Life Sciences content in CAPS has been organised in Grades 10 – 12.

2.6.1 Life Sciences CAPS

Life Sciences, which was previously known as Biology, is regarded as one of the scientific fields of study. As such, whoever studies it goes through the process of learning science, the steps of which include observing a phenomenon, asking a question about the observed phenomenon, trying to think of a plausible answer (hypothesising), coming up with a way to test the hypothesis, collecting data, presenting and interpreting the results, drawing conclusions, and repeating the process if there is a need, to improve the results. Life Sciences is defined as “the scientific study of living things from molecular level to their interactions with one another and their environment” (South Africa. DBE, 2011, p. 8). It was indicated earlier that knowledge evolves with time and this is particularly common in the scientific world as scientists are busy with research and making new discoveries which all contribute to the development of new knowledge (*ibid.*). Life Sciences CAPS promotes acquisition of knowledge, skills and values, and seeks to improve the attitudes of learners towards science because by studying Life Sciences, learners develop:

- their knowledge of key biological concepts, processes, systems and theories;
- an ability to critically evaluate and debate scientific issues and processes;
- greater awareness of the ways in which biotechnology and knowledge of Life Sciences have benefited humankind;
- an understanding of the ways in which humans have impacted negatively on the environment and organisms living in it;
- a deep appreciation of the unique diversity of the past and present biomes in Southern Africa and the importance of conservation;
- an awareness of what it means to be a responsible citizen in terms of the environment and lifestyle choices that they make;
- an awareness of South African scientists’ contributions;
- scientific skills and ways of thinking scientifically that enable them to see the flaws in pseudo-science in popular media; and
- a level of academic and scientific literacy that enables them to read, talk about, write and think about processes, concepts and investigations. (South Africa. DBE, 2011, pp. 8-9)

The Life Sciences content in Further Education and Training (FET) Phase CAPS is divided into four sections known as “Knowledge Strands”. These are indicated in Table 2.1 below, with a summary of the content to be covered in each Grade for a period of a year, showing how this content builds up and links across the Grades and knowledge strands.

Table 2.2: Content covered in each FET Life Sciences Knowledge Strand and Grade, and its progression across Grades and Knowledge Strands

(adapted and modified from: South Africa. DBE, 2011, p. 10)

Knowledge Strand	Content covered in each Grade and its progression		
	Grade 10	Grade 11	Grade 12
Life at molecular, cellular, and tissue level	<ul style="list-style-type: none"> • Chemistry of life <ul style="list-style-type: none"> - Inorganic compounds - Organic compounds • Cell – unit of life • Cell division (mitosis) • Plant and animal tissues 		<ul style="list-style-type: none"> • DNA code of life • RNA and protein synthesis • Meiosis
Life processes in plants and animals	<ul style="list-style-type: none"> • Support and Transport systems in plants • Support systems in animals • Transport system in mammals 	<ul style="list-style-type: none"> • Energy transformations to support life: photosynthesis • Animal nutrition • Energy transformations: respiration • Gas exchange • Excretion 	<ul style="list-style-type: none"> • Reproduction in vertebrates • Human reproduction • Nervous system • Senses • Endocrine system • Homeostasis
Diversity, change and continuity	<ul style="list-style-type: none"> • Biodiversity and classification • History of life on earth 	<ul style="list-style-type: none"> • Biodiversity – classification of microorganisms • Biodiversity – plants • Reproduction – plants • Biodiversity – animals 	<ul style="list-style-type: none"> • Darwinism and Natural Selection • Human evolution
Environmental studies	<ul style="list-style-type: none"> • Biosphere to ecosystems 	<ul style="list-style-type: none"> • Population ecology • Human impact on environment: current crises 	<ul style="list-style-type: none"> • Human impact on environment: current crises Grade 11

The focus of this study is on Biodiversity and all other Biodiversity-related concepts in Life Sciences CAPS, as it is looking at the training of teachers on Biodiversity content knowledge, and how to teach and assess Biodiversity. The teaching and learning of Life Sciences in South African schools has its own purposes and aims, and these are spelt out as follows:

The purposes

- The Development of Scientific Knowledge and Understanding
- The Development of Science Process Skills (Scientific Investigations)
- The Development of an Understanding of Science's Roles in society.

(South Africa. DBE, 2011, p. 12)

The Specific Aims

- Specific Aim 1: Knowing Life Sciences
- Specific Aim 2: Investigating Phenomena in Life Sciences
- Specific Aim 3: Appreciating and Understanding the History, Importance and Applications of Life Sciences in Society

(South Africa. DBE, 2011, pp. 13-17)

The Specific Aims mentioned above serve as benchmarks in the assessment of learners. In planning for assessment, teachers are guided in terms of which verbs to use when setting assessment tasks, and these are also in line with the cognitive levels meant to be achieved by the learners during the assessment per Grade and per year. All these Specific Aims need to have been addressed per Grade by the end of the year. It is not necessary to have addressed all of them in one assessment task. Furthermore, different percentage weightings are allocated to each cognitive level meant to be addressed in tests and examinations. An example of how these weightings are allocated in Grade 10 is presented in Table 2.3 below. The cognitive levels indicated are to be incorporated in all the three Specific Aims when setting an assessment task such as a test, a practical or an examination (South Africa. DBE, 2011, p. 15). It is also evident that Specific Aim 2 is about engaging learners in practical work, so while the skills in doing practical work are tested, the cognitive levels indicated in the table above are also included (*ibid.*).

Table 2.3: Weighting of cognitive levels for learning and assessment for Grade 10 from 2012
(South Africa. Western Cape Education Department (WCED), 2012, p. 3)

Category	Level	Cognitive Levels	Action words	Percentage
A	Lower Order (65%)	Knowing	State, name, list, define, describe	40
B		Understanding	Explain, compare, rearrange, illustrate, calculation	25
C	Higher Order (35%)	Applying knowledge	Predict, apply, use knowledge, demonstrate, solve problems, implement, judge	20
D		Analysis, evaluation and Synthesis	Select, differentiate, analyse, infer, discuss, categorize	15

2.7 Conclusion

This chapter has discussed practice architectures as a theoretical lens for looking at continuing teacher professional development. This theory suggests that a practice is characterised by the thoughts, the ideas and the language one uses which form what are called the sayings. Practices are also characterised by the resources available and the activities being carried out in those practices, all being referred to as the doings; and the relationships, which are called relating, among the practitioners or between the practitioners and the nonliving entities. The theory also highlights the fact that as practices develop, they are shaped, conditioned, modified, enabled or constrained by what are called practice architectures. The ecologies of practices theory was also discussed which describes the interrelationships between the practices to indicate their living nature.

The history of Environmental Education, its importance and inclusion in the curricula of countries of the world including South Africa, and how it is taught, were discussed. Some research studies in teacher professional development were introduced. These highlighted the factors making teacher professional development initiatives effective. The reasons for classroom-based research and the challenges experienced in this field of research were highlighted. Finally, the formulation and implementation of CAPS, the subject content, assessment and weighting in Life Sciences CAPS were also discussed. The next chapter discusses the methodology and the methods used in this study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter introduces the elements of research methodology used in this study, which include the research orientation and the case study approach. It further describes the research sites and the participants involved. The data collection tools used, which include semi-structured interviews, focus group interviews and document analysis, and the ways of analysing the data collected, are discussed. The ethical considerations made when the study was conducted are also presented.

3.2 Research methodology

This section discusses the interpretive and qualitative research orientations used in this study and the reasons for choosing them. A case study approach in research is also described, taking into consideration the opportunities and challenges arising from using this approach.

3.2.1 Research orientation

This research uses a qualitative interpretive approach because a deeper understanding of teachers' experiences and the influence of Fundisa for Change continuing teacher professional development programme on teachers' practice are sought. The research also explores the features of effective teacher professional development activities that Fundisa for Change has, and further looks into the relationality of four practices which are teaching Biodiversity, teacher training, teacher learning and assessment. As Nieuwenhuis (2007a) notes, "Qualitative research typically studies people or systems by interacting with and observing the participants in their natural environment (*in situ*) and focusing on their meanings and interpretations" (p. 51). All the participating teachers in this research have been interviewed to get their ideas about Fundisa for Change training and how it has affected their practice. These teacher interviews were held at their respective schools except for two teachers in Mpumalanga, whose interviews were held outside their work-place. Teacher portfolios which include lesson plans, assessment tasks and teacher reflections on the Biodiversity lessons taught, were also used. The workshop evaluation forms and Fundisa for Change training materials have been used as further sources of data. A qualitative study puts more emphasis on the quality of data obtained and not necessarily on the amount or quantity of such data, hence it does not necessarily involve many research participants. In this research study a total of 18 participants were involved: eleven teachers and seven teacher trainers serving a range of roles in the Fundisa for Change programme.

Roberts-Holmes (2005) stressed that “interpretive research is a belief that we continually create and construct our social world by negotiating with others the meanings of our actions” (p. 40). This means that people attach meanings to their actions and surroundings to understand them. These meanings eventually construct the knowledge which shapes the lives of the people (Nieuwenhuis, 2007a, p. 59). The study looked at teachers’ experiences of Fundisa for Change Biodiversity training they attended and how the training impacted on their teaching practice. The fact that different methods of data collection are normally used in a qualitative study, interviews and document analysis in this study, means that more energy, time and resources are spent than if any other method is used (Hancock & Algozzine, 2006, p.7). This is the challenge faced by case study researchers, but at the end of the day, the use of more than one data collection method is important as it improves the quality and validity of the results because one case is looked at from different angles.

3.2.2 Case study approach

This study was conducted as a case study research. The case under investigation here is the Fundisa for Change continuing teacher professional development programme on the teaching of Biodiversity in two provinces involving eleven teachers, focusing on the research goals stated above. The case study method was chosen because it allows one to have a closer look at the case in question for more understanding. Kumar (1999) explained that “the case study method is an approach to studying a social phenomenon through a thorough analysis of an individual case” (p. 99). Roberts-Holmes (2005) added that since case studies are not carried out on a large scale, the researchers have the ability to devote their energy and resources to “a narrow and clearly defined situation” (p. 47).

Flyvbjerg (2006) argued that case studies are very important and useful as they enable the researcher to study a case more closely and therefore develop a better understanding of the case while at the same time being equipped with skills on how “to do good research” (p. 223). These include, amongst others, careful triangulation of multiple data sources, providing thick descriptions, considering the context of the research in some depth, and being able to delineate the boundaries of the case. In this study, thorough descriptions are presented of the research participants in terms of their professional qualifications, teaching experience, spoken language, gender, and views about the training and how it impacted on their practice. The data were collected using semi-structured interviews, focus group interviews and through document analysis.

3.3 Sample and research sites

This section describes the participants making up the sample for the study. It further describes the areas where the research was conducted. Tables 1.1 and 1.2 give a profile summary of the participants and the research sites.

3.3.1 Research site

The Fundisa for Change Network is coordinated at Rhodes University, which is situated in Makhanda in the Eastern Cape of South Africa. The activities of the network are coordinated by the Environmental Learning Research Centre (ELRC), which is the centre offering Environmental Education courses in the Faculty of Education at Rhodes University. The first formal teacher trainings began in 2013 following the successful piloting of the programme in 2012 (Fundisa for Change programme activities, n.d.). The focus of the study was on two Biodiversity teacher training programmes run in 2013: one in Mthatha in the Eastern Cape, and the other in Mbombela in Mpumalanga. The study included nine public schools where the participating teachers were working. Five of these schools were in Mpumalanga; four were in the Eastern Cape.

With regard to poverty levels, the Eastern Cape has a higher household poverty level than Mpumalanga. It has been reported that in 2011, 47,5% of the households in the Eastern Cape lived below the poverty line, while in Mpumalanga this was 38,3%, compared to 2006 where the figures were 55,8% and 53,8% respectively (South Africa. Statistics South Africa [StatsSA], 2014, p. 44). Many factors affect the academic performance of learners, one of which is poverty (Siyepu, 2013, p. 2). This could be one of the contributing reasons why Mpumalanga performs better in the National Senior Certificate (NSC) as it is relatively wealthier than the Eastern Cape. The Eastern Cape has obtained the lowest NSC examination pass-rate for the last four years: 65.4% in 2014; 56.8% in 2015; 59.3% in 2016, and 65.0% in 2017 (South Africa. DBE, 2018, p. 51). On the other hand, Mpumalanga obtained pass rates of 79.0% in 2014; 78.6% in 2015; 77.1% in 2016; and 74.8% in 2017 (*ibid.*).

3.3.2 Research participants

The identities of the participants and their institutions have not been disclosed but abbreviations are used to identify them as shown in Tables 1.1 and 1.2. The research participants included nine teachers, selected on the basis of their willingness to participate in this study. There are two male teachers and seven female. Four of these teachers, of which all are females, were from East London and Mthatha in the Eastern Cape Province and they all attended the same Fundisa for Change Biodiversity module training in July 2013, held in Mthatha. All these participants speak isiXhosa

as their Home Language and they teach at schools which use English as a medium of instruction. Most of the learners in each of their schools also spoke isiXhosa as their home language. The remaining five teachers were from Mpumalanga. They all spoke SiSwati as their home language except for one teacher whose home language is Sepedi. Two of the five schools had the majority of learners speaking isiZulu as their home language and the remaining three have a higher percentage of learners who speak SiSwati. Teachers seemed to have big classes, as six of the eleven schools have between fifty and sixty learners per class. Three teachers have a Teacher's Diploma while the remaining six have Bachelor's Degrees. Table 3.1 below gives more information regarding the participating teachers in this study.

Seven teacher trainers, five female and two male, also voluntarily participated in the study after being approached. Two of them were based in Johannesburg in the Gauteng Province while the remaining five were based in Makhanda in the Eastern Cape. Currently TT 06 whose highest qualification is Masters in Environmental Education, is the coordinator of the Fundisa for Change network with the assistance from Rhodes University and the University of South Africa (UNISA). TT 07 is an Associate Professor of Environmental Education. TT 01 and TT 03 are full Professors of Environmental Education. TT 02 and TT 04 have PhD degrees in Environmental Education. TT 05 has a Masters in Environmental Education but she is also completing her PhD studies in the same field. All these teacher trainers began their careers as teachers and are actively involved in the Fundisa for Change programme as training facilitators and authors of some of the booklets produced by the Fundisa for Change programme. All of them, except TT 06, are currently lecturers.

Table 3.1: Participant teacher job and academic profile

ID	Gender	Home language (Teachers)	Home language (Learners)	Life Sciences teaching experience (years)	Grades taught	Qualifications
ECT 07	F	isiXhosa	isiXhosa	15	Grade 12	BSc (Zoology 3, Botany 3); HDE; BEd (Physical Sciences)
ECT 06	F	isiXhosa	isiXhosa	1	Grade 10	BEd (FET)
MPT 04	M	SiSwati	SiSwati	1	Grade 10	BEd in Agriculture
MPT 02	F	SiSwati	SiSwati	1	Grade 10	Bed
MPT 05	M	SiSwati	SiSwati	4	Grade 10, Grade 12	Bachelor of Environmental Sciences
MPT 03	F	Sepedi	isiZulu	7	Grade 10, Grade 12	SPTD, FDE, & ACE in Biology Teaching
MPT 01	F	SiSwati	isiZulu	1	Grade 11, Grade 12	BEd (FET)
ECT 05	F	isiXhosa	isiXhosa	2	Grade 8 Grade 9	Senior Teachers Diploma
ECT 04	F	isiXhosa	isiXhosa	3	Grade 10	Senior Teachers Diploma

3.4 Research methods/data generation methods

Two methods of data collection were used: semi-structured interviews and document analysis.

3.4.1 Semi-structured interviews

A set of questions targeting the responses that answer the research questions were developed, and these make what is called an “interview schedule” (Roberts-Holmes, 2005, p. 109). Samples of the teacher interview schedules and teacher-trainer interview schedules are attached as Appendices B and C respectively. Interviews enable one to ask questions and get answers through conversation. To get a deeper understanding of their responses to the questions, in-depth semi-structured interviews were carried out either individually or as a group, with nine teachers who attended the Biodiversity module teacher-training workshop, and seven teacher-trainers. Semi-structured

interviews give one a chance to probe further if the respondent gives an unclear answer. Roberts-Holmes (2005, p. 109) indicated that in a structured interview, “the interviewer has a set of predetermined questions which he/she asks in a set order”. These questions lead the respondent into answering the main questions of the research. Semi-structured interviews allow for broader engagement than contained in structured interviews. While the use of interviews is as important as mentioned previously, one had to overcome several challenges arising from them (Kumar, 1999, p. 115). These included logistics such as travelling, arranging meetings, finding suitable audio-recorders and getting permission from the participants to conduct the interviews.

The face-to-face, one-on-one semi-structured interviews with the participating teachers in Eastern Cape and Mpumalanga were held in May and June 2014 respectively. The responses from the participating teachers are meant to answer all the research questions either directly or indirectly. These questions are about: 1) teachers’ experiences of their Biodiversity training; 2) how the training influenced their teaching practices; 3) practices which characterise Fundisa for Change teacher training programme as an effective one; and 4) the living nature of teaching Biodiversity practices which in this study include teacher training, teacher learning, teaching and assessment of Biodiversity. Each of the participating teachers was interviewed only once.

The teacher trainers were interviewed in October and November 2014, in September 2016 and in May 2017. TT 02 and TT 01 were interviewed in October and November 2014 respectively; TT 01, TT 02, TT 03, TT 04 and TT 05 were interviewed as a focus group in September 2016; and TT 06 and TT 07 were also interviewed together as a focus group in May 2017. Schensul (1999, p. 51) described a group interview, an example of which is a focus (or focused) group interview, as “any discussion held between a researcher and more than one other individual.” Group interviews allow interaction between the participants as they voice out their views about particular matters and large amounts of data can be collected within a very short period of time from many people (Schensul, 1999, pp. 51-52; Cohen, Manion & Morrison, 2007). What is important also about group interviews is the fact that what comes out of the discussions is the ‘collective’ opinion derived after much deliberation from members of the group (Cohen et al., 2007), and they are able to correct each others’ misinformed opinions. While focus group interviews can engage participants in deep discussions about a certain matter, there is not a lot of data that can be obtained from an individual participant and certain participants might dominate the discussions making others shy away (Cohen et al., 2007). I had to allow each member of the group to give their input by probing them for their ideas. TT 01 and TT 02 had been individually interviewed prior to conducting focus group interviews and their responses catered for the shortfalls in the group interviews, and as Cohen et al.

(2007) noted, focus group interviews can be triangulated with other interview forms and other methods of data collection.

The interview responses from the trainers were meant to also answer the research questions, particularly those relating to the training's influence on teachers' practice and the characteristics making the Fundisa for Change teacher training programme effective. The trainers were also meant to reflect on the activities of the Fundisa for Change training programme by looking back from when it was started until the present moment to identify the successes and the challenges. This was done with the hope that future plans would be better implemented and good practices would be improved and sustained. This research study was actually taking place when the programme was undergoing some changes as a new strategic plan was being developed after the end of the first funding period. This meant that the trainers had to be purposively selected taking into account the different roles they played in the Fundisa for Change programme. Purposive sampling is used to select research participants with certain skills, knowledge or experience for them to be able to respond to certain questions. As Cohen et al. (2007, p. 115) reiterated, purposive sampling is meant to identify research participants who are able to meet certain requirements to "satisfy the researcher's needs" and these research participants must have "in-depth knowledge about particular issues". While purposive sampling is said to be 'biased' due to it being 'selective' and not representative of a 'wider population', other sampling techniques might lead one to selecting participants who might be 'ignorant' about some matters relating to the management and coordination of the Fundisa for Change programme (*ibid.*). Also, the management and the coordination of the programme were fully represented in the sample as the management structure is small. The authors of the Teaching Biodiversity module booklet on which the teachers were trained, were also the participants. This means that the researcher was satisfied with the representations among the participants.

All the participating trainers were authors of the Fundisa for Change training materials (see Table 1.2). Some of the booklets written by these trainers include a Biodiversity booklet, Marine Biodiversity booklet, Framing Active Teaching and Learning in CAPS booklet, Teaching Climate Change (Geography Grade 10 – 12) booklet, and Methods and Processes to Support Change-Oriented Learning booklet. Some of the questions asked were directly related to the capacity building objective of the Fundisa for Change programme to try to understand ways by which this objective was (or was not) achieved. This gives this research study an evaluative role in this programme. The managers and the coordinators were meant to share ideas in terms of managing

and coordinating the programme activities to implement the strategic plan. The challenges and opportunities were explored as future plans were considered.

The interview responses were audio-recorded having been given permission to do so by the participants, and were then transcribed. An example of an interview transcript has been attached as Appendix D. The recording of the interview was very helpful because one could playback the interview at any time when the need arose, and the playback could be repeated for the purposes of transcribing. Bailey (2008) indicated that transcribing is itself the beginning of data analysis because decisions are made as to how the ideas from the recordings are put down (p. 127). This is one of the reasons why I transcribed the interviews myself. The transcribing process was done verbatim to put down all the ideas coming from the participants while at the same time recording the emotional state of the participant, for example, when laughing or pausing for thinking. Nieuwenhuis (2007c) remarked that “Laughter or gestures may also give added meaning to the spoken word” (p. 104). Bailey (*ibid.*) further indicated that transcribing allows the researcher to have a closer look at the transcript in order to do more detailed analysis. The recording is also helpful in the sense that it can be digitally stored and used after a long period of time. Transcribing was however a lengthy process. The transcripts developed from the interviews were sent back to the participants for member checking to ascertain that the ideas recorded were in fact theirs. This was also done so that if the participants felt that some of the points they raised were somehow sensitive, they had freedom to remove them. Only two of the participants could not get and respond to their transcripts because of communication problems despite numerous attempts. The interview responses were used to validate the results as the responses were compared with those obtained from the document analysis. The interview responses helped the researcher gain a deeper insight into the respondents’ views.

3.4.2 Document analysis

Bowen (2009, p. 27) described document analysis as “a systematic procedure for reviewing or evaluating documents.” He further indicated that “Like other analytical methods in qualitative research, document analysis requires that data be examined and interpreted in order to elicit meaning, gain understanding, and develop empirical knowledge” (Bowen, 2009, p. 27). Several documents that talk about teacher professional development, CAPS and Fundisa for Change programme were studied. These included the Core Text, which introduces the three pillars of teaching in the Fundisa for Change programme: “Know your Subject; Improve your Teaching Practice, and Improve your Assessment Practice” (Fundisa for Change programme, 2013, p. 2). The Biodiversity Module booklet specifically deals with the Biodiversity content knowledge in CAPS, how to teach and assess it. The Methods and Processes booklet, which is about the different teaching

methods, why and how they are used, was also analysed. These Fundisa for Change programme documents were studied for a deeper understanding of the programme activities and how they are run.

The teacher portfolios were also analysed for insights into teachers’ practices, and how the teachers had internalised and applied the Fundisa for Change professional development programme learning. The Biodiversity training evaluation responses of the participating teachers were analysed to get their views and experiences about Fundisa for Change training. The Biodiversity training evaluation form is attached as Appendix E. The Life Sciences CAPS document was analysed for an insight as to how Life Sciences is represented in the curriculum, particularly the Biodiversity section. A document log, attached as Appendix F, has been developed giving more information about the documents used. Table 3.2 below shows the documents used and the codes assigned to them. The information obtained from these different sources was triangulated with each other and with the information from the semi-structured interviews to get a true sense of what is really happening, in order to answer the research questions. Laws (2003) in Bell (2005, p. 116) said that “the key to triangulation is to see the same thing from different perspectives and thus be able to confirm or challenge the findings of one method with those of another”.

Table 3.2: Documents used and their codes

Document used	Date of production	Who produced the document?	Code assigned
Life Sciences CAPS: Grades 10-12	2011	DBE	LS-CAPS
Fundisa for Change Implementation Plan	2013	Fundisa for Change	IP
Introductory Core Text	2013	Fundisa for Change	CT
Teaching Biodiversity: Life Sciences Grades 10-12	2013	Fundisa for Change	BB
Teacher training workshop evaluation forms	2013	Participant teachers	E
Teacher portfolios	2013	Participant teachers	TP
Fundisa for Change Final Report (2013-2015)	2016	Fundisa for Change	FR

3.5 Data analysis

Inductive and abductive approaches to data analysis were used in this study. For the interview transcripts and document analysis, data analysis was done in such a way that the answers to the questions were grouped according to certain concepts or themes out of which coding was done. According to Leedy and Omrod (2005, p. 138): “The data are categorised according to their meanings. Patterns, regularities and critical events are identified.” The themes identified from the data were selected in order to address the questions asked. Coding is the process of looking closely into the data and trying to find the words or statements that are meaningful, then assigning an

identifying number, symbol, label, word or a descriptive statement to such a section (Nieuwenhuis, 2007c, p. 105). Nieuwenhuis (*ibid.*) further noted that coding makes it easy for the researchers to combine “all the text and other data that they have associated with some thematic idea so that the sorted bits can be examined together and different cases compared in that respect.”

NVivo, which is a computer software program used to aid data analysis, was used in this research. It helped in the identification and development of the themes and in coding while manually working with the data. This software was used after carefully familiarising myself with the data. NVivo has been helpful in the sense that data analysis was done faster than manual coding would have allowed. Azeem and Salfi (2012) indicated that NVivo helps the researcher to work with the data as “it offers a variety of analyzing tools for developing new understandings and theories about the data and testing of answers to research question” (p. 262). An example of NVivo coding is given as Appendix G. Analytical memos, including direct quotes from the participants, were developed from the identified themes. These analytical memos helped in assembling all the ideas making up a particular theme. A sample of an analytical memo has been attached as Appendix H.

Data were analysed in two phases. There were several steps taken in each phase of the data analysis to minimise the errors or challenges associated with the process. Phase 1 involved two steps. The first step was transcribing the interviews. As I was going through this process I was able to highlight the responses which I thought were going to help me answer the research questions. Transcribing also helped me know my transcripts better. The second step involved reading the transcripts and the documents several times to get a better understanding of their content while at the same time identifying the relevant themes for coding. These identified themes were allowed to come out of the data while bearing in mind what the research questions wanted. This process is called an inductive approach. The following table gives a sense of how data were analysed in Phase 1.

Table 3.3: Phase 1 inductive data analysis process

Source of information	Themes					
	Experiences	Influence on content knowledge	Influence on teaching methods	Influence on assessment strategies	Effective practices	Other ideas
Participant						

In an inductive approach, one looks for “similarities in a number of observations and draws the conclusion that these similarities also apply to nonstudied cases” (Danermark, Ekstrom, Jakobsen & Karlsson, 2002). In an inductive approach, themes are allowed to emerge from the data collected, and an analytical table was used for this.

Furthermore, in Phase 2, an abductive approach was used which involved two steps. The first step involved the use of the theory of practice architectures as a data analysis tool (Hemmings et al., 2013, p. 475) for data collected from the interviews and document analysis. Practices in the Fundisa for Change continuing teacher professional development programme have their own sayings, doings and relatings. In sayings, for example, one looked at whether or not trained teachers gained new knowledge or understanding in the three pillars of CAPS, which are content knowledge (in this case environment and sustainability content knowledge), teaching and assessment strategies. In doings, for example, one looked at whether the trained teachers were able to use their skills in their teaching practices and also do things differently. In relatings, for example, one looked at how trained teachers were able to relate to other people (for example, other teachers and the learners) and to other non-human entities including the environment. Danermark et al. (2002) indicated that in an abductive approach, one seeks “to understand something in a new way by observing and interpreting this something in a new conceptual framework”. In this approach the theory of practice architectures was used to analyse the raw data in terms of the sayings, doings and relatings.

Not only were the sayings, doings and relatings considered, but also the enabling and constraining conditions under which the teaching practice was unfolding. These enabling and constraining conditions are called practice architectures, as highlighted in the previous chapter. They are cultural-discursive factors which shape the language characteristics or the sayings, realised in semantic space. There are also material-economic factors which shape the activities, time and the use of space available, realised in physical space-time; and social-political factors which shape the relationships among humans and between humans and nonhuman entities, realised in social space. The practice architectures hold or bundle together the sayings, doings and relatings for a particular practice. Appendix I represents the theory of Practice Architectures framework, which was used in the analysis of data in the first step of Phase 2. The questions in the following table, as suggested by Kemmis, McTaggard and Nixon (2014, pp. 81-82), served as a guide throughout the data analysis in the first step of Phase 2.

Table 3.4: Investigating practices and practice architectures that support them

Elements of practices	Practice architectures in the site
<p><i>Project</i> What do participants – including myself and others – say they are doing, or intend to do, or have done? (Note: different participants and others may answer this question differently)</p>	<p><i>Practice landscape</i> How do different participants (and others involved or affected) inhabit the site in different ways, that is, interact with different people and objects, and occupy different places and spaces in the site as a whole?</p>
<p><i>Sayings (communication in semantic space)</i> What do different participants say in the practice as they do it (what language is used, especially specialised language used in this practice)? What ideas are most important to different participants? What language and ideas do different participants use about the practice (especially to describe, explain, and justify the practice before and after they do it)? How are different participants’ language and ideas changing?</p>	<p><i>Cultural-discursive arrangements (Note: one person’s sayings are also practice architectures that enable or constrain others’ sayings)</i> Where does this language or special discourse come from (e.g., texts, policies, professional communities, language communities)? Who speaks this language in the site? Who speaks it most/least fluently? Is there contestation among people involved or affected about the language, or key ideas or importance?</p>
<p><i>Doings (activities, often producing or achieving something, in physical space-time)</i> What are participants doing? Are there sequences or connections between activities? Are ends or outcomes being achieved?</p>	<p><i>Material-economic arrangements (Note: one person’s doings may enable or constrain others’ doings)</i> What physical spaces are being occupied (over time)? Are particular kinds of set-ups of objects involved? What material and financial resources are involved? (Are the resources adequate?)</p>
<p><i>Relatings (relationships in social space, especially relationships of power and solidarity)</i> How do participants (and others involved or affected) relate to one another? Are there systems of positions, roles or functions? Are relationships of power involved? Who is included and excluded from what? Are there relationships of solidarity and belonging (shared purposes)?</p>	<p><i>Social-political arrangements</i> What social and administrative systems of roles, responsibilities, functions, obligations, and reporting relationships enable and constrain relationships in the site? Do people collaborate or compete for resources (or regard)? Is there resistance, conflict or contestation? Is the communicative space a public sphere?</p>
<p><i>Dispositions (habitus; the interactive capabilities of different participants)</i> <i>Understandings:</i> How do participants understand what is happening? <i>Skills:</i> What skills and capacities are participants using? <i>Values:</i> What are participants’ values, commitments and norms relevant to the practice (concerning the people and things involved)?</p>	<p><i>Practice traditions</i> What do our observations tell us about practice traditions in the site, in the sense of ‘the way we do things around here’? Is there evidence of professional practice traditions (not exclusive to this site) – like following an inquiry approach in science teaching, or following a state policy – and do these enable or constrain what participants hope to achieve in this site?</p>

Source: Kemmis, McTaggart and Nixon (2014, pp. 81-82)

The second step of the abductive approach in Phase 2 of the data analysis involved the use of the theory of the ecologies of practices. Practices are said to interrelate, thereby forming what are called ecologies of practices and as such they are regarded as living entities (refer to section 2.2.2). These interrelationships are investigated from the interaction between teaching Biodiversity, teacher-training, teacher-learning and assessment practices. Furthermore Table 2.1 was used to describe the interrelationships between these practices and their living nature, by looking at the characteristics of living practices they possessed. Step 2 in Phase 2 of the data analysis is presented in Chapter 6 to answer Question 4 which explores the interrelationships between practices and their living nature. The process of data analysis is summarised in the figure below.

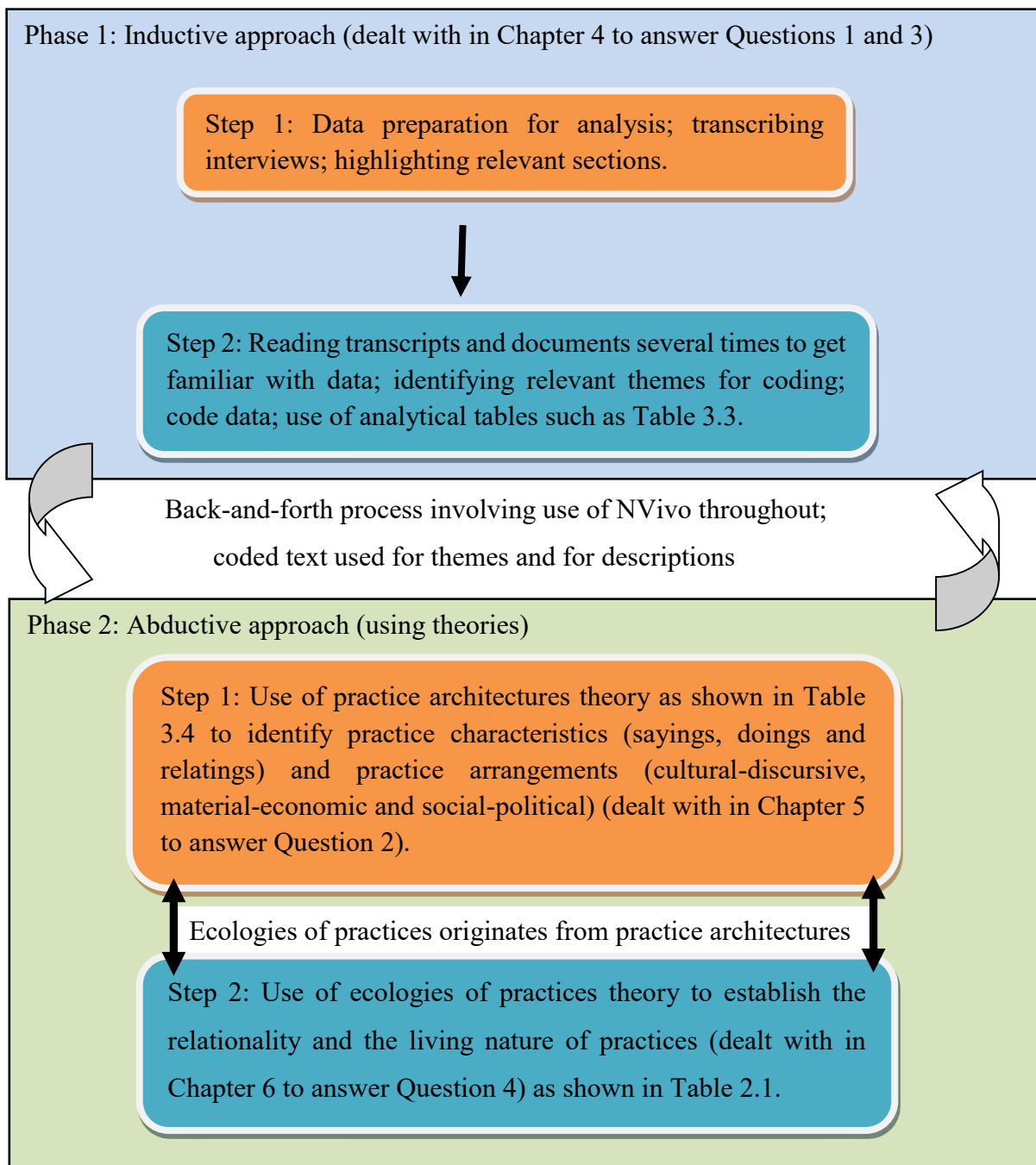


Figure 3.1: Data analysis process used (adapted from Creswell, 2012, p. 237)

3.6 Ethics

Bassey (1999, p. 74) indicated that there are three important elements of ethics in research: respect for democracy, respect for truth and respect for persons. These are meant to remind researchers that their freedom in research such as freedom of speech is bound by responsibilities that must be adhered to, they must be honest and true about their research methodologies, and they must treat the participants with respect (*ibid.*).

The views of the participants about the training would not necessarily be those held by all the members of their cultural groups, gender or institutions. Confidentiality and anonymity regarding the names of the participants and the institutions where participants are working or teaching have been strictly adhered to. If the identities of the participants need to be disclosed, I still have to ask for permission from them to do so as this is what we agreed. Permission was sought from the Department of Basic Education officials in each of the two provinces (refer to the access letters attached as Appendices J and K), the school principals of the participating teachers, the teachers themselves and the teacher-trainers. The participants were informed about the purpose of the research before they decided to take part. Consent letters detailing confidentiality and anonymity about the data collected were signed by both the participants and the researcher. The consent letters for participating teachers, school principals and teacher-trainers are attached as Appendices L, M and N respectively. Ethical clearance was also granted by the university, as indicated by the ethical clearance letter attached as Appendix O. As Christensen and Johnson (2000, p. 71) noted:

- Researchers have a responsibility to be mindful of cultural, religious, gender and other significant differences within the research population in the planning, conduct and reporting of their research.
- Informants and participants have a right to remain anonymous.

I treated all the participants with respect, and their views were treated with confidentiality. An interview schedule was used as mentioned earlier, and the audio-based data collected has only been used internally in the research for transcribing and interpretation. It will not be used for other purposes without permission from the participants.

3.7 Validity/ Trustworthiness

Validity refers to an indication of whether the instrument measures what it is expected to measure. Face validity and content validity were used to validate the research instruments (interview questions and document analysis) before they were used. To ensure face validity, the research instruments were distributed to my supervisors, some lecturers, and other students doing masters

and doctoral degrees, for their comments. Their comments on the research instruments in general (i.e. the language used and the questions themselves) were acknowledged and necessary changes were made. As Pietersen and Maree (2007, p. 217) noted, “face validity refers to the extent to which an instrument ‘looks’ valid”. Content validity is the measure of whether the instrument covers the content it is meant to cover (Pietersen & Maree, 2007, p. 217). This means that my interview questions had to address the research objectives and the main research questions.

Addressing issues of validity further, I made every effort to capture every idea when transcribing the interviews and then gave the transcripts back to the participants for member checking. I also had an opportunity in some cases to do a brief tour of the participants’ schools to understand the context further. During data analysis, I went over each transcript several times in trying to find the emerging themes which were then triangulated across all transcripts and other data sources such as the pictures, lesson plans, workshop evaluation forms, teacher reflections on their teaching practice and learner marks. Hancock and Algozzine (2006) indicated that “a case study researcher synthesises the many disparate pieces of information acquired during the research process in order to identify and report meaningful findings” (p. 61). The common themes were then summarised in a form of analytical statements which were then presented through detailed descriptions. During the entire research process, I was guided by the research goals, the research questions, the research methodology, and the conceptual and theoretical frameworks. Hancock and Algozzine (2006) further indicated that “the primary characteristic of reporting findings when doing case study research is repetitive, continual review of obtained information to identify answers to questions being investigated” (p. 62). I have also presented my research work to fellow students and researchers whose inputs were very constructive. This is important as it allows other researchers to “systematically and thoroughly critique the study’s procedures and findings in order to identify discrepancies that may threaten the credibility of the research effort” (Hancock & Algozzine, 2006, p. 66). Case study research provides a detailed insight of a particular situation instead of making broad generalisations (Nieuwenhuis, 2007b, p. 76). However, Bassey (1999) indicated that case studies provide “fuzzy generalisations”, meaning that they can be starting points for large-scale studies whose results could then be generalised.

3.8 Limitations

The scope of the research study was however limited due to the fact that it looked only at Fundisa for Change continuing teacher professional development programme and it focused only on the Biodiversity module in three training contexts. The teacher training on Biodiversity was structured to cover the environment and sustainability content specified in CAPS, from Grade 10 to 12. The

module consisted of three different but related units, and in each unit the Biodiversity content knowledge, teaching strategies and assessment methods were discussed. The training was run such that teachers were actively involved. The sample of the research, which was 16 participants (seven teacher-trainers and nine teachers), further limited the study. Time also limited the study as it had to be completed within a specified period. I would like to have observed some Biodiversity lessons, but due to time constraints and some teachers not being available because of teaching external classes and other reasons mentioned in section 2.5, I could not manage this. Some teachers did not complete their portfolio tasks, thus they could not be included in the study as their practices were not documented. However, most of those who submitted their portfolios could not participate as they were unwilling to, as indicated in section 2.5. The challenges of teachers not submitting their portfolios timeously and their reluctance to be observed are some of the factors which delayed the study. Recent research studies on Fundisa for Change programme were considered to address this issue. A case study method on its own is a limiting factor as it looks at a specific case, in this instance, the Fundisa for Change programme. The research results could not therefore be widely generalised. The research was however worth doing for the reasons mentioned previously, in section 1.4.

3.9 Conclusion

This chapter dealt with methodology and data gathering methods used. It further described the sites where the study was carried out and the participants involved. Data handling, processing and analysis methods were introduced and discussed. Ethical processes and validity measures employed were explained. The limitations of the study were also highlighted. The next chapter presents the data generated and the first phase of data analysis in the study.

CHAPTER 4:

THE FUNDISA FOR CHANGE CPD PROGRAMME: CHARACTERISTICS AND TEACHERS' EXPERIENCES

4.1 Introduction

This chapter discusses the process followed during data generation and analysis in Phase 1, which comprised inductive analysis of semi-structured interviews, workshop evaluation responses and the documents. The categories emerged from the data in Phase 1. The codes assigned to the documents used in this research as indicated in Table 3.2 are used for reference. The chapter begins by looking at the Biodiversity content in CAPS, how to teach and assess it. The Fundisa for Change Teacher Training programme is also described, with more focus on Biodiversity as a topic. Data presentation and analysis is used to answer Research Questions 1 and 3. Phase 2 comprised a two-step abductive analysis of Biodiversity lessons. Step 1, which is discussed in Chapter 5, used the theory of practice architectures, and Step 2 discussed in Chapter 6, used the theory of ecologies of practices.

4.2 The Biodiversity section of the Life Sciences CAPS curriculum

The allocated time for Life Sciences content in the FET Phase is four hours per week (LS-CAPS, p. 7). All the Life Sciences content in Grades 10 and 11 must be covered in 32 weeks, while in Grade 12, it must be covered in 27¹/₂ weeks of the 40 weeks making up the school year (LS-CAPS, p. 19). There are expectations by DBE with regard to the allocation and use of resources in schools to facilitate the process of teaching and learning Life Sciences, as laid down in the CAPS document.

- *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 safely.*
- *Ideally, every learner should have access to sufficient workspace and equipment to carry out investigations. For safety reasons, no more than three learners may share space and equipment in instances where space and equipment are limited due to large classes. With regard to equipment, schools must make every effort to ensure that the essential equipment is provided.*
- *While it is acknowledged that it is not ideal to use improvised equipment, teachers should remember that it is more important for learners to have the experience of carrying out a variety of investigations than to depend on the availability of standard laboratory equipment. If equipment is limited, teachers should be encouraged to improvise. The same skills can be developed using improvised equipment. Moreover, if there are no alternatives,*

it is more effective for teachers to demonstrate an investigation than to not do investigations at all due to lack of equipment. Secure storage for equipment and chemicals must be provided by the school.

- *Teachers should ensure that learners are familiar with rules regarding the safe use of equipment and chemicals. The Life Sciences classroom or laboratory should be equipped with charts, Bunsen burners or spirit lamps, hand lenses, bioviewers and relevant biostrips, microscopes, a set of prepared slides, glass slides and cover slips, reference books, blades or scalpels, models, field guides, identification keys, thermometers, glass beakers, test tubes and chemicals, and, if at all possible, access to appropriate DVDs and a DVD player.*
- *Fresh plant material can be obtained from the surroundings and teachers should ensure that appropriate plants (e.g., Impatiens) are planted on the school grounds. Fresh animal material can very often be obtained at reasonable prices from local butchers.*
- *Teachers must be qualified to teach the subject and must familiarise themselves with the equipment and how it is used. (LS-CAPS, pp. 19-20)*

This section presents Biodiversity content, progression, assessment strategies and teaching methods as set out in the Life Sciences CAPS curriculum.

4.2.1 Biodiversity content

Table 2.2 in section 2.6.1 provided a summary of all the Life Sciences topics covered in the FET Phase (Grade 10 to Grade 12) as set out in the Life Sciences CAPS document. The principles, purposes and Specific Aims of the Life Sciences CAPS curriculum were described in section 2.6, which also included the skills, values and attitudes that the future citizens of the country are expected to have when they come out of the education system. It should be noted here that even if certain sections will stand out as explicitly falling under the Biodiversity section, the topic itself is very broad and it encompasses, and relates to, many other sub-topics which might not be easily identifiable in the CAPS curriculum. The scope of the Biodiversity content is presented in Appendix P as it is explicitly portrayed in the FET Life Sciences CAPS document. The period of time during which the Biodiversity topics are covered, the assessment requirements and the possible resources that can be used are also given.

The information in Appendix P shows that in Grade 10, the Biodiversity topics start to be taught in Term 3, and they fall under Strand 3, which is Environmental Studies. The main topics are Biosphere, Biomes, Environment and Ecosystems. These topics have to be taught for a period of 24

hours spread over six weeks. During this period fieldwork has to be carried out, the guidelines for which are also explained in CAPS.

The Biodiversity content in Grade 10 continues into Term 4 in which Strand 4 is covered. This strand deals with Diversity, Change and Continuity. The main topics covered are Biodiversity and Classification. These topics are covered in four hours, equivalent to one week. The section, Diversity, Change and Continuity, forms Strand 1 in Term 1 in Grade 11, and continues to be covered. The main topics covered here are Biodiversity and classification of microorganisms, for a duration of 12 hours; Biodiversity of, and reproduction in, plants, for 12 hours; and the Biodiversity of animals for 8 hours (LS-CAPS).

4.2.2 Content knowledge progression

The continuation of Diversity, Change and Continuity from Grade 10 in Term 4 into Grade 11 in Term 1 shows a very significant element in CAPS, which is that of progression: the fact that the same topic continues from one Grade into another with the content knowledge becoming progressively deeper. The example here is the introduction of the concept of Classification in Grade 10, Term 4, under Diversity, Change and Continuity (Strand 4), progressing into Term 1 in Grade 11 where classification of organisms is carried out. Progression also happens within the Grades in the same topic, in that when the topic is introduced one starts with basic ideas about the topic but as time progresses the knowledge gets deeper and deeper. For example, in Grade 10, Term 3 under Environmental Studies, one needs to understand the concept of an Ecosystem before talking about biotic and abiotic factors and how they relate to each other. Progression also happens across the topics within the same Grade. For example, in Grade 10 it is important to understand the leaf structure covered in Term 2 under Life at Molecular, Cellular and Tissue Level (Strand 1). This will later help one understand how the leaf structure is related to the concept of transpiration, covered under Life Processes in Plants and Animals (Strand 2) in Term 2. This later becomes important also to understand the concepts of Biomes and Ecosystems covered in Term 3 under Environmental Studies (Strand 3), why particular plants are able to survive in certain areas and not in others, which is also a concept of adaptation (LS-CAPS).

4.2.3 Assessment in Life Sciences

The CAPS document indicates that

Assessment is a process that measures individual learners' attainment of knowledge (content, concepts and skills) in a subject by collecting, analysing and interpreting the data and information obtained from this process to:

- *enable the teacher to make reliable judgements about a learner's progress;*
- *inform learners about their strengths, weaknesses and progress; and*
- *assist teachers, parents and other stakeholders in making decisions about the learning process and the progress of the learners.*

Assessment should be mapped against the content and intended aims specified for Life Sciences and in informal and formal assessments it is important to ensure that in the course of the year:

- *all of the subject content is covered*
- *the full range of skills is included; and*
- *different forms of assessment are used. (LS-CAPS, p. 66)*

Assessment plays a very big role in CAPS: it is clearly stated in each section or strand what form of assessment should be carried out, for how long, and which skills are to be covered in the assessment. Though formal assessment in the form of tests, practicals, assignment projects and examinations is used to determine the learners' progress, informal assessment in the form of worksheets, homework, written essays, class tests, reports, presentations, and many other informal assessment strategies can be used. These various modes of assessment help the teacher to reflect on the teaching and learning process. Informal assessment also includes self-assessment, in which learners assess themselves, and peer assessment in which learners are assessed by other learners, and it is not necessarily for recording purposes. These informal and formal assessments are called *assessment for learning* and *assessment of learning* respectively (LS-CAPS, p. 66). *Assessment for learning* is about getting feedback from the learners' work in terms of whether learning is taking place or not, so that it can be improved if necessary, and *assessment of learning* is about assessing what learners have learnt for recording and promotion purposes (*ibid.*). It is also stressed that in both formal and informal assessment, feedback to the learners about their work is very important for them to keep track of their performance (*ibid.*). The assessment should cater for different cognitive levels in learners in each Grade, as noted in Section 2.6.

A programme of formal assessment for Life Sciences in each Grade is set out in CAPS. A Grade 10 programme of assessment is given in Table 4.1 below as an example. The table indicates that at least three practical tasks are required, and the assessment of Environmental Studies in Term 3 includes fieldwork. There is also a practical examination, which might include a Biodiversity topic. The assessment tasks shown in Table 4.1 below represent the minimum number of tasks required, and teachers are always encouraged to give learners more tasks to identify areas where they struggle, and thus increase their chances of succeeding.

Table 4.1: Grade 10 programme of formal assessment

FORMAL, RECORDED, SCHOOL-BASED ASSESSMENTS				END-OF-YEAR INTERNAL EXAMINATION 75%	
Content		Practical		Two Written Examinations (2½ Hours + 2½ Hours)	Practical Examination (1 Hour)
<ul style="list-style-type: none"> • Four tests (minimum of 50 marks each) • One midyear examination (2½ hours 150 marks) • One project/assignment (can be done in any term: 100 marks in the fourth term) • Skills are listed under Specific Aims 1 and 3 		<p>A selection of three representative practical tasks, which cover the range of skills, must be marked and recorded. (The marks allocated for a practical task should range from 20 to 40.)</p> <p>The range of skills is described in Specific Aim 2.</p>		<p>This exam tests knowledge on content, concepts and skills across all topics. Knowledge of practical work as well as some of the skills related to practical work must be assessed in the written examination.</p> <p>80% = 60%</p>	<p>This exam tests practical knowledge and skills. This should be set by each teacher taking into account the resources that are available for practical examination.</p> <p>20% = 15 marks</p>
School-based Assessment (During the Year)				75	
Term 1	Term 2	Term 3	Term 4		
<ul style="list-style-type: none"> • One test • One selected practical task 	<ul style="list-style-type: none"> • One test • One selected practical task • Mid-year examination 	<ul style="list-style-type: none"> • One test • One selected practical task • Environmental studies: field work 	<ul style="list-style-type: none"> • One test • One project/assignment 		
25%	25%	25%	25%		
Convert to 25%				75%	

(Source: LS-CAPS, p. 68)

The end-of-year examination in Grade 10 consists of three examination papers, one being a practical examination and the other two being based on the content. This is the same as in Grade 11 but different in Grade 12, in that there is no practical examination. The two examination papers based on subject content are still there in Grade 12. The examination papers based on the subject content are very structured, with teachers having been told which topics must be covered by the questions

and for how many marks. An example of how examination question papers 1 and 2 in Grade 10 Life Sciences are structured is given in Tables 4.2 and 4.3 below.

Table: 4.2: Grade 10 Life Sciences examination paper 1 structure

Topic	Time	Weighting	
		%	Marks
T1 (Term 1):			
• Chemistry of Life	2 ¹ / ₂ weeks	16	23
• Cells: Basic Units of Life	3 weeks	17	25
• Cell Division: Mitosis	2 weeks	12	18
• Plant and Animal Tissues	1 week	5 (50)	9
T2 (Term 2):			
• Plant and Animal Tissues	2 weeks	13	20
• Plant Organs (Leaf)	¹ / ₂ week	3	5
• Support and Transport Systems: Plants	3 weeks	17	25
• Support Systems: Animals	3 weeks	17 (50)	25
	17 weeks	100%	150

(Source: LS-CAPS, p. 71)

Table: 4.3: Grade 10 Life Sciences examination paper 2 structure

Topic	Time	Weighting	
		%	Marks
T3 (Term 3):			
• Transport Systems in mammals	3 weeks	20	30
• Biosphere to Ecosystems	6 weeks	40 (60)	60
T4 (Term 4):			
• Biodiversity and Classification	1 week	7	10
• History of Life and Earth	5 weeks	33 (40)	50
	15 weeks	100%	150

(Source: LS-CAPS, p. 71)

Table 4.3 is particularly important as it shows the structure of the examination paper in terms of the Biodiversity content (Biosphere to Ecosystems and Biodiversity and Classification). It is clear from the table above that nearly half of paper 2 (47%) contains Biodiversity content. It is therefore very important that teachers have Biodiversity content knowledge and the ability to mediate knowledge to the learners in such a way that learners understand it and are able to pass at the end of the year. Tables 4.2 and 4.3 help teachers to teach with an understanding of what kind of assessment learners will be exposed to. This idea of teaching with assessment in mind assists teachers in selecting the appropriate teaching methods in order to cater for those particular assessment strategies selected. This is also what is stressed in Fundisa for Change training.

Moderation plays a major part in assessment as a way of ensuring that the assessment tasks set meet the requirements and are of the appropriate standard. There is internal and external moderation. Internal moderation occurs at school and it is normally the Head of Science Department or the Head of the subject committee who moderates the assessment task. The moderation report is then produced, which the teacher takes to the cluster moderation meeting for external moderation. This is where teachers from different schools moderate each other's work, and the subject advisor or the curriculum specialist from the District Education Department does the final check of the teacher's assessment tasks. A report is also produced, which the teacher takes back to the school. It is stipulated in the CAPS document,

Moderation refers to the process that ensures that the assessment tasks are fair, valid and reliable. Moderation should be implemented at school and district level and if necessary at provincial level. Comprehensible and appropriate moderation practices must be in place for the quality assurance of all subject assessments. (LS-CAPS, p. 74)

4.2.4 Teaching methods

The selection and use of a teaching method is a very important aspect of the teaching and learning process because the method used is related to the content to be taught and the assessment to be carried out at the end of the teaching and learning process. For example, one cannot use a lecture method with learners in a classroom setting, to learn about different types of Biomes and how the plants found in them are adapted to living there, and then expect them to complete a practical investigation task on identifying the characteristics of plants living in certain areas. Learners have to actually go out and see what is being described. CAPS does not suggest a wide variety of teaching methods. It focuses on investigations which include fieldwork and practical work. The CAPS document states that *"It does not prescribe particular instructional strategies or methodologies. Instead, educators have the freedom to expand concepts and to design and organise learning experiences according to their local circumstances, including the availability of resources"* (LS-CAPS, p. 10). This is an indication that teachers are at liberty to choose a range of teaching methods they like in teaching Biodiversity. However, as the teaching method relates to the content to be taught and the assessment to be given, this could be a problem in a situation where a teacher lacks content knowledge in that respect, or experience of aligning content, assessment and teaching methods.

4.3 Fundisa for Change continuing teacher training programme

The Fundisa for Change teacher training programme was introduced in section 1.2, and as described earlier, it is aimed at helping teachers implement the environment and sustainability content knowledge in CAPS by training them in subject content knowledge, teaching methods and assessment methods. The Fundisa for Change Implementation Plan (IP) describes the programme's rationale as follows:

The Fundisa for Change Partnership Programme rationale is based on a need for measures to strengthen the schooling system in ways that ensure capable teachers, a coherent curriculum, and high quality learning materials to resource the foundations of further learning and participation in the environment, global change and biodiversity Human Capacity Development pipeline. Working systemically within a national system of engagement at the level of teacher education and curriculum policy, the partnership programme is required to ensure longer term impact. (IP, p. 5)

The Fundisa for Change objectives, main activities and intended results for the period 2013 to 2015 are attached as Appendix Q. A summary of the objectives is provided below:

- *Objective 1: Capacity building for teacher educators;*
 - *Objective 2: Policy and advocacy influence;*
 - *Objective 3: Build a national system of engagement for environmental learning and teacher education;*
 - *Objective 4: Strengthen curriculum and teaching support materials, especially textbooks; and*
 - *Provide coordination support to establish the Fundisa for Change Partnership programme.*
- (IP, pp. 8-9)

The Fundisa for Change training programme was initially strategically planned to run its activities for a period of three years, from 2013 to 2015, out of which the experiences, challenges or opportunities were used to shape its future plans and its continuity since then. The Fundisa partners have developed a new strategic plan for the programme with the activity of the training of teachers and trainers continuing. Looking back over the first three years of the programme, much was achieved. Several training sessions for teachers and teacher trainers were run from as far back as 2012 when the programme was piloted until the present. However, the data generation of this study was mainly focused on the first three years of the programme, i.e. the period 2013 to 2015. The following table summarises the training conducted, in line with Objective 1 of the Fundisa for Change Programme.

Table 4.4: Fundisa for Change training carried out from 2013 to 2015

Training programme	Date	Numbers Trained	Accrediting university	Fundisa for Change module
Eastern Cape Training of Trainers	17 – 19 April 2013	22	Stage 1 Training of trainers	Generic modules
Western Cape Training of Trainers	30 – 2 May 2013	27	Stage 1 Training of trainers	Generic modules
Gauteng Training of Trainers	13 – 15 May 2013	27	Stage 1 Training of trainers	Generic modules
Mpumalanga Training of Trainers	20 – 22 May 2013	27	Stage 1 Training of trainers	Generic modules
Accredited Training of Trainers programme, Rhodes University	18 – 20 June 2013	16	Stage 2 Training of trainers	Generic modules
Mpumalanga Teacher Training	9 – 12 July 2013	14	Rhodes University	Biodiversity - FET Life Sciences
Eastern Cape Teacher Training	12 – 14 July 2013	13	Rhodes University	Biodiversity - FET Life Sciences
Gauteng Subject Advisor Training	20 – 21 August 2013	15	Rhodes University	Biodiversity - FET Life Sciences
Northern Cape Teacher Training	16 – 18 July 2013	15	University of Cape Town	Climate Change – FET Geography
Western Cape Teacher Training	23 – 25 September 2013	15	University of Cape Town	Climate Change FET

Eastern Cape Training of Trainers	26 – 30 September 2014	45	Stage 1 and 2 Training of trainers	Generic modules
National Training of Teachers (Gauteng)	29 June – 5 July 2014	80	Water summit (Department of Water Affairs)	Water GET
Eastern Cape Teacher Training (Dwesa)	20 – 22 August and 13 – 15 November 2014	12	Rhodes University	Marine Biodiversity - FET Life Sciences
Eastern Cape Teacher Training (Grahamstown)	19 – 21 September and 17 – 18 October 2014	11	Rhodes University	Biodiversity – FET Life Sciences
Gauteng Training of Subject Advisors	22 – 26 September and 22 October 2014	14	North-West University	Water – Intermediate and Senior Phase Social Sciences
KwaZulu-Natal Teacher Training	30 September – 1 October and 4 – 5 February 2015 and 21 – 22 April 2015	14	Rhodes University	Life and Living – Intermediate Phase, Natural Sciences and Technology
Limpopo Training of Subject Advisors	9 – 11 February 2015 and 9 – 10 March 2015	27	North-West University	Water – Intermediate and Senior Phase Social Sciences
Mpumalanga Training of Subject Advisors	16 – 19 February 2015 and 6 May 2015	15	Rhodes University	Water – Intermediate and Senior Phase Social Sciences
Limpopo Training of Subject Advisors	23 – 25 February 2015 and 23 – 25 March 2015	26	Rhodes University	Biodiversity - FET Life Sciences

Western Cape Teacher Training	27 – 28 February 2015 and 6 – 7 March 2015	23	University of Cape Town	Biodiversity - FET Life Sciences
Western Cape Teacher Training	13 – 14 March 2015 and 27 – 28 March 2015	13	University of Cape Town	Climate Change – Senior Phase Natural Sciences
Limpopo Training of Subject Advisors	17 – 19 March 2015	20	University of Cape Town	Climate Change – FET Geography
Limpopo Training of Subject Advisors	23 – 25 March 2015; Follow-up in August 2015	32	Rhodes University	Healthy Living – Foundation Phase, Life Skills
Northern Cape Teacher Training	29 June – 1 July 2015	24	University of Cape Town	Water – Intermediate Phase
Western Cape Teacher Training	8 – 10 July 2015	24	University of Cape Town	Climate Change – FET Geography
KwaZulu-Natal Training of Teachers	13 – 15 July 2015	30	Rhodes University	Climate Change – Senior Phase Natural Sciences
Eastern Cape Teacher Training (Uitenhage)	13 – 14 July 2015	30	Rhodes University	Biodiversity FET Life Sciences
KwaZulu-Natal Training of Teachers	18 July – 20 July 2015	19	Rhodes University	Climate Change – Senior Phase Natural Sciences

(Adapted from: Fundisa for Change Programme Final Report (Phase 1) – 2013-2015, pp. 16-17)

All the activities under objective 1 were carried out as planned. During the three year period “164 trainers [partners], 337 teachers and 149 subject advisors” were trained (Fundisa for Change Programme Final Report [FCR], p. 17). These figures are greater than the targeted numbers of trained teachers (30 teacher clusters) and teacher-trainers (100) for that period. Seven provinces had already been covered by the end of 2015. At the end of 2016, 10 subject specific exemplars had

been produced together with 3 generic exemplars, and 534 teachers, 169 subject advisors and 164 partners had been trained (FCU1-2017). A teacher education conference (Activity 3.1) was also held in Johannesburg from the 27–28 February 2014 in which several teacher education issues were discussed. These issues included:

- Transformative Environmental Learning through Teacher Education;
- Knowledge Representation, Research and Material Development for Teacher Education; and
- Teacher Education Theory and Practice for Transformative Environmental Learning. (Fundisa for Change programme, 2014)

The points mentioned above were discussed on the first day of the conference. During the second day, workshops were held on the following themes:

- Transforming teacher education qualifications and programmes to include environmental learning and ESD;
- Teachers' subject knowledge and experience of 'new' environmental concepts and teaching practices;
- teaching methods and assessment for transformative environmental learning and ESD – how to integrate these into teacher education programmes; and
- Professional learning communities and continuing professional development of teachers (Fundisa for Change programme, 2014).

Objective 5 activities have also been carried out thus far as there is a coordinator who has been contracted, and a system of monitoring and evaluation is in place. There may be more developments than the ones mentioned as some of the programme activities are currently being implemented. My main focus is however on Objective 1 activities, within the 2013 – 2015 period.

This research examines the first objective, which is that of capacity building for teachers. As indicated earlier, the focus in this research is on the teacher training held in Eastern Cape and in Mpumalanga in July 2013, during which the teachers were trained on Biodiversity. The Fundisa for Change programme has also run many other trainings as Table 4.4 above shows. It produced teacher education materials which are grouped into two types of materials. The first group consists of 'core materials', which include a Core Text booklet, a Methods and Processes booklet and an Active Teaching and Learning in CAPS booklet. The second group consists of 'subject-specific materials' which help teachers teach environment and sustainability content in these specific subjects (Fundisa for Change programme, n.d.). These subject specific booklets are on a range of environmental topics

such as Biodiversity, Climate Change, Water, Marine Biodiversity, Healthy Living, Life and Living and Indigenous Knowledge Systems, and they cater for different Phases. The core materials help improve the “quality of education” (Fundisa for Change programme, n.d.). The table below lists the booklets that were produced in the period 2013 - 2015, the subject and Phase they are meant for.

Table 4.5: Fundisa for Change Programme booklets produced

Title of booklet	Subject and Phase
Introductory Core Text	Orientation to the Fundisa for Change Programme
Methods and Processes	Teaching methods for transformative learning
Active teaching and learning in CAPS	Curriculum Assessment Policy Statement
Healthy Living	Life Skills, Foundation Phase (Grade R - 3)
Indigenous Knowledge and Technology	Natural Sciences and Technology, Intermediate Phase (Grade 4 - 6)
Life and Living	Natural Sciences and Technology, Intermediate Phase (Grade 4 - 6)
Water	Social Sciences, Intermediate Phase (Grade 4 - 6)
Water	Social Sciences, Senior Phase (Grade 7 - 9)
Climate Change	Natural Sciences, Senior Phase (Grade 7 - 9)
Climate Change	Geography, FET (Grade 10-12)
Water	Geography, FET (Grade 10-12)
Biodiversity	Life Sciences, FET (Grade 10-12)
Marine Biodiversity	Life Sciences, FET (Grade 10-12)

(Adapted from: FCR, p. 14)

All these booklets are intended to help teachers implement the new CAPS curriculum in their specific subjects. The booklets are also approved by SACE to be used during training for the teachers to acquire their continuing professional development points. These training sessions are run as short courses worth 15 SACE points or long courses worth 20 SACE points. The booklets that are of particular interest in this study are the Biodiversity booklet and the Core Text. This section discusses the contents of the Biodiversity booklet and the Core Text. It further describes the two Biodiversity teacher training workshops in question.



Figure 4.1: Samples of Fundisa for Change Programme booklets

4.3.1 Fundisa for Change booklets: The Core Text and the Biodiversity booklet/module

4.3.1.1 Core Text (CT)

The Core Text starts by explaining the rationale behind the inclusion of the environment and sustainability content in many school curricula in the world, including the South African CAPS curriculum. This rationale is based on environmental degradation problems and the need for teachers to sensitise the youth about sustainable ways of living (CT, p. 2). It further explains why Fundisa for Change offers the training to the teachers:

It [Fundisa for Change training course] seeks to support the professional development of knowledgeable and skilled teachers who have the capacity, the will and the interest to teach children about the world in which they live, and to equip them to participate successfully both now and in future. The course develops the knowledge and skills of teachers, enabling them to make reasoned choices about their lives and their teaching. It encourages teachers to develop the values and ethics needed for a more just and sustainable world. It does this through supporting and extending the environment and sustainability content, methods and assessment practices that are outlined as a ‘minimum’ in the CAPS. (CT, p. 2)

There are three focus areas in the Fundisa for Change training programmes. These are, content knowledge (Know your Subject), teaching practice (Improve your Teaching Practice), and assessment practice (Improve your Assessment Practice) (CT, p. 2).

4.3.1.1.1 Know your subject

This section introduces the principles enshrined in the Constitution which are also incorporated into CAPS and linked to the objectives of UNDESD. These principles were highlighted in section 2.6. Some of the subjects in which the environment and sustainability content is explicitly included are mentioned. These are Life Sciences, Geography and Life Orientation (CT, p. 7). As is indicated in the document, *“Life Sciences requires learners to focus on Biodiversity. They need to understand life support systems and processes; basic ecological principles; and environmental impacts and how to assess these”* (CT, p. 7).

The Fundisa for Change identified several concerns related to teachers’ environment and sustainability content knowledge:

1. The need for teachers to have foundational knowledge of the core concepts in Environmental Education

This foundational knowledge will provide a basis for understanding new and complex issues. As is indicated in the document: *“Environmental issues are generally complex Without a sound understanding of certain core concepts and processes, it is unlikely that an environmental issue will be adequately understood”* (CT, p. 8). This is particularly problematic due to the fact that some of the teachers lack foundation in environment and sustainability content knowledge, as indicated earlier, due to their not having studied this kind of knowledge at school or during their training.

2. The contentious nature of environment and sustainability content knowledge

People have different views about the various environmental concepts, and the knowledge changes from time to time, as was explained in section 2.3. The Core Text indicates that *“At school, textbooks generally present information as unquestioned, cut-and-dried facts. However, the fact that environmental and sustainability knowledge is most often linked to issues means that this knowledge is contested ...”* (CT, p.8).

3. Teachers seem to struggle with the issue of knowledge progression, an example of which was given in section 4.2.2. As explained in the Core Text:

Another issue that needs attention is knowledge progression and quality. Research shows that many teachers are ‘under-teaching’ learners. This means that not enough attention is being given to the age- and grade-appropriateness and quality of what is taught at different levels. Nor is sufficient attention paid to progression, or how to build on knowledge year by year. (CT. P. 9)

Fundisa for Change therefore develops subject-specific units such as the Biodiversity unit to help teachers tackle the abovementioned problems. It is further indicated that:

Each teacher will have different environmental content requirements, depending on their particular subject and Grade. Throughout the programme teachers will work with their particular curriculum statements and textbooks. In addition, they will use the course units and examples, which will expand and extend their knowledge beyond the minimum requirements of CAPS, with a view to becoming more ‘knowledgeable’ teachers. (CT, p. 9)

4.3.1.1.2 Improve your teaching practice

This section is about the teaching methods for teaching environment and sustainability content better and thereby improving student learning. There are many different teaching methods at teachers’ disposal, but which method is selected for what content and for what assessment strategy are very important questions that must be answered before a particular method is finally adopted. As noted in the Core Text:

At the heart of quality education lies good teaching practice. A number of teaching methods are common to all subjects, but in addition each subject or discipline has its own particular ‘embedded methodology’ or ways of creating knowledge. For example, the Sciences favour investigative methods. ... These disciplinary ‘characteristics’ influence teaching practice, and have implications for how environmental content is taught and assessed. (CT, p. 10)

Teachers are strongly advised to choose teaching methods that actively engage learners (refer to section 2.6) in the process of teaching and learning because “*the CAPS subjects contain environmental content, and require learners to engage actively with complex social and ecological concepts, issues and risks relating to local and global contexts*” (CT, p. 11). These teaching methods should also promote “*critical and creative thinking skills*” in learners as they interact with the environmental issues (CT, p. 11). It is also stated that a variety of methods can be used in one lesson to enhance understanding. The methods that are “*particularly relevant to environmental learning include experiential methods, investigative methods, ‘learning by doing’ methods, and deliberative methods*” (CT, p. 11).

4.3.1.1.3 Improve your assessment practice

The assessment methods as explained in CAPS are described giving an example of a Grade 11 programme of assessment. These methods are the same as those explained for Grade 10, as was described in section 4.2.3 of this chapter. The point is made, however, that:

Even though CAPS provides very structured guidance on assessment, the teacher still needs to think through assessment carefully, and to develop effective assessment strategies. Good assessment practice greatly enhances the quality of teaching practice, especially if assessment is seen as an important part of the learning process. Good quality assessment provides learners with useful feedback on their progress, and helps teachers to get to know learners and to identify the kind of learning support they need. (CT, p. 16)

Assessment of learning and assessment for learning are also described. Assessment of learning considers learners' needs and it works towards improving their performance, but assessment of learning comes at the end of the learning process, the purpose of which is for *promotion and certification* (CT, p. 17) (Quoted from CAPS, Geography, 2011).

4.3.1.2 Biodiversity booklet (BB)

This booklet has been written specifically to guide teacher learning relating to the Biodiversity topics that appear in FET Life Sciences CAPS. It is meant to help teachers acquire more Biodiversity content knowledge, and improve their teaching and assessment skills. The booklet starts by defining the term 'Biodiversity' and the reasons why it is important. The information in the booklet is divided into units, and in each unit the content (Subject content knowledge), the teaching methods for that particular content (Teaching practice) and the assessment strategies for that particular content (Assessment practice), are discussed. This unit arrangement is the same as discussed in the Core Text (in section 4.3.1.1), that is: Know your subject, Improve your teaching practice and Improve your assessment practice. Unit 1 deals with what Biodiversity is; Unit 2 is about the Roles of Biodiversity while Unit 3 deals with Human Impact on Biodiversity and responses.

4.3.1.2.1 Unit 1: What is Biodiversity?

4.3.1.2.1.1 Subject content knowledge

This section identifies the topics in CAPS that describe what Biodiversity is all about. As is indicated in the booklet, this section covers the following areas:

1. *Defining key concepts (including Biodiversity, species, population, genus, community, habitat, ecological niche, ecosystem, trophic levels and biomes)*
2. *South African biomes (including Succulent Karoo, Nama Karoo, Savannas, Fynbos, Grasslands, Thicket, Forest, Wetlands, Marine and Coastal Ecosystems)*

3. *Taxonomic classification (naming and grouping organisms in a hierarchically ordered system that reveals their natural or evolutionary relationships)*
4. *Identification instruments or tools (for identifying species).* (BB, p. 10)

Then the Biodiversity topics in the FET Phase as they appear in CAPS are displayed in a table on pages 10 to 12 in the Biodiversity booklet. These are the same topics that have been shown in Appendix P, except that in the booklet, resources, time and assessment methods have not been indicated. It is the content, the term and the Grade that are indicated. The concepts are thoroughly explained and activities for the teachers are included in each of the sections 1 to 4 mentioned above. Teachers did some of these activities during training to get a feeling of what learners would experience and also to know the challenges of carrying out such activities. As ECT 04 indicated “*Because whatever you need to do with your own learners, then that's what they [teacher trainers] teach you to do, so that when you go back to school, you exactly know what is it that you need to do with your own learners ...*” (ECT 04-I, paragraph 193). An example of an activity on Biodiversity concepts is given below:

ACTIVITY 2

EXPLORING BIODIVERSITY

Media analysis and outdoor investigations

Learning focus:

Development of scientific knowledge (information) and understanding of biodiversity and related concepts, critical analysis, visual art, report writing and presentation skills.

Resources:

Selected articles on local biodiversity issues from local newspapers or magazines or from the Internet, dictionaries (scientific dictionaries where possible) and Life Sciences textbooks. You can ask the learners to find these articles where resources are available.

(i) Media analysis – identifying key words and concepts

Vocabulary development (scientific literacy) (Grade 10, term 3)

Divide the learners into groups and ask them to list different terms and concepts that they come across in the selected article. Ask them to find and discuss the meanings of these different terms in the group. Ask the learners to summarise the main focus/theme of the

article according to their own understanding. The group should then present the topic and the terms to the class.

(ii) Media analysis – article review, critical analysis

(Grade 10, term 4; Grade 11, term 1)

Using the same article, ask learners in the group to discuss the main points the article is trying to make. Are these points supported by relevant facts? What are the underlying assumptions? Do they agree with the proposed viewpoint of the author(s)? Ask them to suggest how the message contributes to responses to biodiversity loss. The learners should write down their deliberations as an article review report.

(iii) Outdoor investigation – Show and tell (listening with intent – information transfer)

(Grade 10, term 3)

Take learners to a nearby natural area and ask them to take detailed notes of observations and information provided. Explain to them the type of ecosystem that you are investigating (seek the help of an experienced guide/conservationist if necessary). Point out the different species in the environment and their natural habitats. Explain to them the relationships between the different components in the ecosystem and discuss the roles of the different species. Ask them to write an essay describing the ecosystem and the different relationships of the components within it (using their notes). In the essay they should include a drawing representing what they saw during the visit.

(Source: BB, pp. 17-18)

The activity shows three important aspects that Fundisa for Change encourages teachers to do:

1. Active involvement of the learners in the process of teaching and learning, and also allowing them to play a central role, as MPT 02 also indicated that one must make teaching and learning “*learner-centred, not teach-and-talk*” (MPT 02-I, paragraph 251).
2. Use of local and readily available resources; the sentiment shared by ECT 04, ECT 05 and ECT 07 in section 4.3.4.5.
3. Identification of the skills that the activity is addressing.

4.3.1.2.1.2 Teaching practice

This section is about the teaching methods that teachers can use to teach learners the general Biodiversity concepts outlined in sections 4.3.1.2.1.1 above. The point is highlighted that no single method of teaching these concepts would be suitable. Teachers have to use a range of methods to cater for the different learning styles of the learners. As the booklet indicates:

A mixture of practical action-oriented aspects in real life contexts as well [as] classroom-based activities can facilitate learning on this topic. These include investigative, experiential, learning by doing and deliberative methods as discussed in the Introductory Core Text and Methods and Processes booklet. Some activities are suitable for group-work while some are individual activities. Using a diverse range of teaching and learning approaches creates opportunities for learners to actively engage in the learning process.
(BB, p. 29)

These different teaching methods should also be able to improve skills, which are important in the teaching and learning of Biodiversity. These are scientific language skills related to the many terms and concepts the learners need to deal with, especially also as most are learning Biodiversity in a different language from their own. Analytical skills are also needed to deal with complex environmental issues. Critical decision-making skills are important when dealing with issues like Biodiversity loss. Mathematical skills are involved in working with data and being able to draw graphs, analyse them and make predictions into the future (BB, p. 29). The teaching methods mentioned in this unit are applicable to Unit 2 and Unit 3.

4.3.1.2.1.3 Assessment practice

This section is about how learners can be assessed when dealing with Biodiversity terms and concepts. Assessment methods will differ depending on the Biodiversity content and the skills being assessed (BB, p. 30). An example of how assessment can be used in this section is presented in the table below:

Table 4.6: Linking content knowledge to assessment processes – Unit 1

CONTENT KNOWLEDGE SECTION	SECTION SUMMARY	ASSESSMENT ACTIVITY	KEY ASSESSMENT SKILLS (VERBS)
Definition of key biodiversity concepts	The concept of Biodiversity is based upon the principle of hierarchies and the basic building block is the species. Understanding the levels of biodiversity and the associated terminologies. South African biomes.	<ol style="list-style-type: none"> 1. Review of selected texts/articles on biodiversity to identify key terms and concepts. (Grade 10, 11) 2. Investigation of a local natural ecosystem (Grade 10) [Practical activity] 	Define, describe, list, name, observe, recall, illustrate, measure, record (draw)
Taxonomic classification	Taxonomic classification as a systematic process of naming and identifying living organisms following the system developed by Carolus Linnaeus. Hierarchical classification/ranking process.	<ol style="list-style-type: none"> 1. Identification and classification of organism with the school yard or garden (Grade 10, 11) [Practical activity] 2. Development of a simple taxonomic key (Grade 10, 11) [Practical activity] 	Identify, name, organise, categorise, list, classify, select, differentiate, design, develop, use/application of knowledge.

(Source: BB, p. 30)

The booklet also gives an information table (Table 1.7) indicating how the Specific Aims are linked to the different cognitive skills expected to be acquired by the learners, and which areas the assessment process should focus on with respect to addressing a particular cognitive skill (BB, pp. 31-32). The information is very helpful to teachers because the examples of the assessment activities given demonstrate how teachers can set activities incorporating the Specific Aims and cognitive skills. A programme of formal assessment as it was explained in Table 4.1 in section 4.2.3 is also provided (BB, p. 33). The booklet further gives a list of assessment methods and tools that the teacher can use to assess Biodiversity units in general. These are outlined in Table 4.7 below.

Table 4.7: List of some possible assessment methods and tools/instruments

ASSESSMENT METHOD	ASSESSMENT TOOLS/INSTRUMENTS
Case studies and open problems	Checklists, assessment grids and rubrics
Classroom-based discussions	Discussion checklist
Computer-based assessments	Multiple choice questions (MCQs)
Direct observation	Observation sheet
Self-assessment	Self-assessment questions
Peer assessment	Peer assessment questions
Essays	Essay checklist
Knowledge tests	Short answer questions
Learning logs/diaries	Checklists, assessment grids and rubrics
Mini-practicals	Practical checklist
Orals	Oral assessment checklist
Portfolios	Portfolio of evidence guideline/checklist
Poster sessions	Poster checklist
Presentations	Presentation checklist
Quizzes	Checklists, assessment grids and rubrics
Problems	Checklists, assessment grids and rubrics
Projects	Project checklist
Interviews	Questionnaires
Reflective practice assignments	Practical checklist
Practical demonstrations	Practical checklist
Reports (on practicals)	Report forms
Simulated interviews	Interview questionnaire
Written examinations	Multiple question examinations single essay examinations, modified essay questions (MEQs), multiple choice questions (MCQs)

(Source: BB, pp. 33-34)

These methods can be used in combination, so that the teacher gets a clear understanding of whether learning has occurred. Different assessment methods also cater for a wide range of learners with different learning needs, and they can be used formally and informally. The table above does not necessarily indicate that the suggested assessment tools can only be used with the corresponding assessment methods. As the Biodiversity booklet says:

... there is no hard and fast rule as to which type of assessment tools should be used with particular assessment types. Some assessment tools can be used across a range of assessment methods. It is also essential to employ a variety of assessment methods and instruments as well as to provide interesting and challenging tasks that are imaginative and engaging to the learners and yet still meet the required assessment objectives. (BB, p. 34)

The assessment practices suggested in this unit can be used in Unit 2 and Unit 3.

4.3.1.2.2 Unit 2: The roles of Biodiversity

4.3.1.2.2.1 Subject content knowledge

The content is covered in Grade 10, in Terms 1 and 2. It is generally about the importance of Biodiversity, and includes Ecosystem services and human well-being (BB, p. 36). The topics related to this section are shown in the table below.

Table 4.8: Topics related to Ecosystem services and human well-being

SUB-THEME	CONTENT	BIODIVERSITY RELATED TOPICS IN CAPS-LIFE SCIENCES	GRADE	TERM
<i>Ecosystem services and human well-being</i>	Life support systems and processes Biodiversity resources Livelihood sustenance	Provisioning: ▪ Food: Chemistry of Life (pp. 23-24) ▪ Medicine: Applications of Indigenous Knowledge Systems and Biotechnology (p. 28)	10	1
		Regulation & Support ▪ Energy flow through ecosystems – cycles (water, oxygen, carbon dioxide, nitrogen) – flow charts (p. 34)	10	3
		Cultural: ▪ Tourism and cultural heritage: ecotourism (p. 34)	10	3

(Source: BB, p. 36) (The page numbers in the table shown in brackets are CAPS page numbers)

The Ecosystem services, according to the Biodiversity booklet, are grouped into:

- Provisioning services: the services that supply material goods like water, food, freshwater, and many more;
- Regulating services: the services that control such processes as climate change, pollination, flood, and many others;
- Cultural services: the services associated with tourism, aesthetic aspects of life, spiritual aspects, education, and many others; and
- Supporting services: the services associated with nutrient cycling, soil formation, and many others. (BB, p. 37)

This section also has activities that teachers can give to learners as classroom assessment tasks, as also discussed in section 4.3.1.2.1.1.

4.3.1.2.2.2 Teaching practice

The Biodiversity teaching methods suggested in section 4.3.1.2.1.2 can also be used to teach this content.

4.3.1.2.2.3 Assessment practice

The following table gives an example of how this particular section can be assessed. This example can be used in combination with assessment methods indicated in Table 4.6 in section 4.3.1.2.1.3.

Table 4.9: Linking content knowledge to assessment processes – Unit 2

CONTENT KNOWLEDGE SECTION	SECTION SUMMARY	ASSESSMENT ACTIVITY	KEY ASSESSMENT SKILLS (VERBS)
Role of Biodiversity	Diverse range of services provided by biodiversity (to human kind and to the environment), both realised and the future potential	Survey of local plant uses (Grade 11) [Practical activity]	Design/plan an investigation, measuring, recording, illustrate (draw graphs), interpretation

(Source: BB, p. 42)

4.3.1.2.3 Unit 3: Causes of Biodiversity loss and emerging human responses to Biodiversity loss

4.3.1.2.3.1 Subject content knowledge

This section explains the negative impact of humans on Biodiversity and what they are doing in trying to mitigate this impact. This content is taught in Grade 11 in Term 4 as it was shown in Appendix P. The human activities that cause these negative impacts as depicted in the Biodiversity booklet (BB, pp. 46-47) include:

- *Habitat change*: where human beings are clearing land for activities such as mining, agriculture, housing and other developments;
- *Pollution*: which involves the release of harmful substances into the environment;
- *Overexploitation*: this refers to the excessive extraction and unsustainable use of resources such as overfishing and deforestation without thinking about future implications;
- *Invasive alien species*: these are species foreign to a particular place but have been brought in, resulting in changing the composition of the ecosystem and hence the balance of nature which in many cases lead to other species being extinct; and
- *Climate change*: the process in which the normal local, regional or global climatic patterns change due to global warming, which results from over-production of greenhouse gases. Climate change leads to processes such as flooding and desertification which also lead to the loss of certain species.

The fact that humans depend on Biodiversity for ecosystem services, the loss of Biodiversity has a negative impact on them. As elaborated in the booklet:

Loss of biodiversity negatively affects (diminishes) the ability of ecosystems to provide goods and services to humankind. This is more apparent in local communities that rely directly on natural resource goods and services for their daily livelihood sustenance. For example women having to walk longer distance to get firewood due to deforestation or fetch water due to drought and desertification. (BB, p. 47)

The human responses to Biodiversity are also discussed. It is indicated that no single approach can be a solution to these environmental problems, an integrated approach is essential (BB, p. 48). The responses to Biodiversity loss include:

- *Environmental Education and Education for Sustainable Development (ESD)*: the need for Environmental Education and ESD, and their inclusion in CAPS was discussed in section 2.3 of Chapter 2. The main aim is to engage citizens in working with new knowledge of environmental issues so that they can live and deal with the environment in a sustainable way. An example can be that of educating farmers on the sustainable practices of farming;
- *Indigenous conservation practices*: Some indigenous people have been able to sustain Biodiversity for a long period of time. Their practices included rotational farming and protection of certain animal and plant species for belief purposes;
- *Traditional (western) protected areas*: this means the introduction of nature reserves, national parks and state owned botanical reserves;
- *Collaborative management and community-based natural resource management (CBNRM)*: This involves partnership between the community, government and the private sector in a bid to protect Biodiversity;
- *Ex situ conservation*: This involves the protection of threatened and endangered species through breeding and creation of ‘gene banks’;
- *Non-consumptive use of biodiversity*: An example can be fishing for recreational purposes where fish are caught and brought back to their environment; and
- Other control measures which include private game reserves, invasive alien control, policy and regulation, and low carbon and green economy initiatives. (BB, pp. 50-52)

4.3.1.2.3.2 Teaching practice

A range of Biodiversity teaching methods can be used as indicated in section 4.3.1.2.1.2.

4.3.1.2.3.3 Assessment practice

It was indicated in section 4.3.1.2.1.3 that different assessment methods are available for teachers to use in assessing Biodiversity content as displayed in Table 4.6 in section 4.3.1.2.1.3. However for this content (Unit 3) in particular, the following ideas are suggested:

Table 4.10: Linking content knowledge to assessment processes – Unit 3

CONTENT KNOWLEDGE SECTION	SECTION SUMMARY	ASSESSMENT ACTIVITY	KEY ASSESSMENT SKILLS (VERBS)
Responses to Biodiversity issues	Varied emerging responses to Biodiversity concerns and their (positive and negative) implications	<ol style="list-style-type: none"> 1. Role play of park-community conflict (Grade 11) 2. Debate on elephant crisis in Kruger (Grade 10, 11) 3. Public survey – opinion poll on elephant culling (Grade 11) [Practical activity] 4. Research on energy sources and their implications (Grade 11) 	<p>Recall, debate, discuss, predict, critically analyse, solve problems, use knowledge, write/synthesise</p> <p>Design/plan an investigation, using equipment properly and safely, measuring, recording, interpretation</p>

(Source: BB, p. 55)

The documents introduced provide a basis for further analysis and interpretation of data.

4.3.2 Fundisa for Change Biodiversity teacher training – Mpumalanga and Eastern Cape

The two teacher training programmes to be discussed here are those that were held in July 2013 in the Eastern Cape and in Mpumalanga. The Mpumalanga training was held from 9–12 July 2013 while the Eastern Cape training was held from 12–14 July 2013. Both training programmes were held in specified locations where teachers were provided with accommodation and food. The teacher trainers who ran these training programmes were first trained by Fundisa for Change programme. Four of these trainers (TT 01, TT 02, TT 05 and TT 06) have voluntarily participated in this study. The training workshop programmes are attached as Appendix R for Mpumalanga training, and Appendix S for the Eastern Cape training.

Each of the training programmes began with an orientation into Fundisa for Change training programme, in which the overall goal and the objectives of the programme, and the rationale behind its establishment, were introduced to teachers. Refer to section 4.3 for these. Then followed a session in which teachers explored the Biodiversity topics in CAPS, the issues of progression and also assessment requirements as stipulated in CAPS. Issues of setting assessment tasks catering for a range of different cognitive levels in learners were also highlighted. Teachers were also made aware of the fact that assessment is linked to the teaching methods one uses. The Biodiversity booklet and CAPS documents were used in this section. Then the next major activity was that of looking at the teaching methods commonly used to teach environment and sustainability content, in this case Biodiversity. This is where the booklet on Methods and Processes was introduced. Teachers then went on fieldwork where they were also guided on how to use fieldwork in the teaching of Biodiversity. All the content in Unit 1 to Unit 3 in the Fundisa for Change Biodiversity booklet (BB) was introduced to teachers and activities were given out to do. Teachers were actively involved as they were working in groups preparing presentations, and they sometimes worked on activities during the evening. Teachers were also given an opportunity to reflect on the activities of the day, so that if there were any challenges, they could be addressed immediately. All in all the Fundisa for Change teacher training programmes are similarly structured in the sense that the three main focus areas of the Fundisa for Change programme are covered. Some of the general comments teachers made about the training programmes are discussed in section 4.3.4.5.

The last part of the training was the introduction of an assessment task for the teachers. The assessment of teachers after participating in any professional development initiative is a requirement from SACE if that type of professional development is to be accredited and endorsed. The assessment was such that teachers had to compile a portfolio of evidence on the Biodiversity lesson presented in which the teachers were to show the content covered, the teaching methods and the assessment strategies used. The teacher had to prepare a lesson plan to show these details. Furthermore, the teacher had to show the knowledge progression in the topic being taught, and he or she had to critically reflect on the teaching practice and assessment methods used. This means that the portfolio assessment task was structured the same way as the training workshop, where the first part dealt with the Biodiversity content that the teacher had selected to teach, then the second part dealt with the teaching methods used by the teacher to teach the topic, and the last part dealt with the assessment of the learners on the content taught. The main purpose of the portfolio assessment task was to see if the teachers were able to implement what they had learnt from the training workshop. The following table shows the marks obtained by the participating teachers on their portfolio assessment task.

Table 4.11: Teacher portfolio assessment scores

Portfolio assessment scores			
Eastern Cape participants		Mpumalanga participants	
Participant ID	Mark (%)	Participant ID	Mark (%)
ECT 05	55	MPT 01	83
ECT 06	70	MPT 02	67
ECT 07	77	MPT 03	76
		MPT 04	64
		MPT 05	60
Scores for non-participants		Scores for non-participants	
1	70	1	62
2	68	2	57
3	93	3	32
		4	66
		5	68
		6	51
		7	61
Average	72		62

(Non-participants are those teachers who did not participate in the study)

Six teachers in the Eastern Cape and twelve in Mpumalanga completed the portfolio assessment task. The general performance of the teachers was good, with an average mark of 72% in the Eastern Cape, and 62% in Mpumalanga. The participant with the lowest score in the Eastern Cape was not a regular Life Sciences teacher. In the case of Mpumalanga, one teacher could not get a pass mark of 50%, the reasons for which are not known because the teacher was not part of the study. The scores and what teachers said in relation to their experiences of the training programme in section 4.3.4, are an indication that the teachers were able to implement the skills and ideas acquired from the Fundisa for Change training. While several teachers have talked about the portfolio task being too demanding, I think research can be carried out to determine the constraints teachers encounter in the completion of the portfolio task as several trainers also commented on low percentages of successful completion of this task.

4.3.3 Characteristics of Fundisa for Change continuing teacher training programme

4.3.3.1 Active involvement of teachers

In the two training workshops time was allocated for practical activities and fieldwork. In the Eastern Cape, participating teachers visited a local coastal area during the second day of the training to study an ecosystem as depicted in the training workshop programme (see Appendix S). The following are comments from some of the Eastern Cape teachers. ECT 04 indicated that in the Fundisa for Change training workshop,

... if they [trainers] gonna [going to] teach about something, they take you to the environment that they are gonna teach about, let you touch whatever you're going to be taught about, let you see how you can ... like necessarily, they take you as a learner, in those trainings for Fundisa for Change neh? (ECT 04-I, paragraph 193)

The activities the teachers were engaged in included some practicals. ECT 06 indicated that “we also had practicals. So we had compost, and then they showed us how to look for certain organisms like animals and everything then we took them, then we used the microscope because they were so tiny” (ECT 06-I, paragraph 243). ECT 06 further stipulated that “we had to go out there and identify maybe what you learnt when we were doing the ... like ... when we were in the ... the workshop ...” (ECT 06-I, paragraph 257).

The Mpumalanga teachers also commented on how the training was run. This is what MPT 01 had to say about the training workshop she attended:

... as part of the training there was a day when we went to the Botanical Gardens, and there was this worksheet that we were given to complete. It was a Grade 10 worksheet I think, but it was ... it was so insightful for us, it was so useful, because instead of just sitting and being taught, you know, we went out, which is what science is all about. (MPT 01-I, paragraph 170)

MPT 04 also indicated that a lot of workshop activities allowed them to be actively involved as they were doing practicals, and they also had a chance to have a field visit where they were able to see and work with nature: “the lessons that we conducted were not theoretical. Most of them were practical. We were taken out to the field to identify things” (MPT 04-I, paragraph 196).

The teacher-trainers, as the people who were responsible for planning and running the training workshops, seemed to have had this idea of actively involving the teachers in the training. As TT 01 stipulated: “we came out with some practical things the teachers could do” (TT 01-I, paragraph 29). He further indicated that Fundisa for Change programme had a mandate to provide teachers with the relevant skills and information on how to meaningfully use fieldwork as a way of taking ideas out of the classroom into the real world to enhance student learning:

We need both the tools that the teachers have to teach with, and we need the articulation into the real world what the children are learning. And the one thing that was notable about that East London example, is that the coastal environment, the coastal bush, was very very useful for people to see succession, and also for people to get ... er ... keying out the plants

that were there and kind of understanding the ecological function of the various plants, and the form and function adaptations of plants in those situations. (TT 01-I, paragraph 46)

TT 02 talked broadly about the Fundisa for Change training programmes to highlight the fact that teachers are actively engaged during the training. She gave an example of the training that had been recently conducted in the Eastern Cape in an area called Dwesa, where teachers had to show how humans negatively impacted on the environment by doing a short role play:

... in the training in Dwesa, during the first session, we had to role play human impacts on the marine ecosystems, different teachers were given different roles, for example some were alien invasive species, some were crabs, some pollution and so on, and teachers in the second training session indicated that they used the same strategy in their classroom to teach human impact on the ecosystems. (TT 02-I, paragraph 16)

Active participation involves not only hands-on activities. People working together in groups and being involved in robust discussions are also actively engaged, which was what the teachers did. TT 02 further indicated that the teachers in the workshop

... were given activities in groups to encourage discussions among themselves. Some activities included the use of dichotomous key in classification; having an excursion to identify different biomes and constructing food chains and food webs; analysis of assessment tasks to help teachers with setting questions papers that cater for different cognitive levels in Bloom's Taxonomy. (TT 02-I, paragraph 38)

4.3.3.2 Assessment of teachers

One of the important aspects of Fundisa for Change was the assessment of teachers to see if they were able to implement the knowledge and skills they had acquired. The assessment was also a requirement by DBE for teacher trainers to make teachers provide evidence of what they had learnt during the training workshops for their training to be accredited. Fundisa for Change used a portfolio method to assess teachers. Teachers had to compile a portfolio of evidence on the Biodiversity lesson taught. In the portfolio, they had to include the lesson plan which showed the topic that was to be taught, the description of the content, the teaching methods and the assessment methods. Teachers also had to reflect on their teaching of the lesson and the assessment methods used. As TT 01 indicated,

The portfolio evidence was considered to be what was really important to be assessed. ... the new policy now on professional learning communities also articulates with that notion of being able to produce evidence. ... and I think that the taking of the work from the training

course back into the school becomes critically important in any kind of training. So it's the combination of the history of the portfolios, the need to get the training to transfer into the real situation, and the teachers to show evidence of thoughtful work ... (TT 01-I, paragraph 67)

TT 02 also indicated that Fundisa for Change assesses teachers even though from her observation, the teachers were reluctant to compile portfolios. She said: “*teachers are also assessed in a form of portfolios, and this is a very tricky part as teachers are reluctant to do it*” (TT 02-I, paragraph 30).

4.3.3.3 Following up on trained teachers

TT 02 acknowledged the importance of following up on teachers: “*Following up on the teachers after the training to find out how they are coping in implementing the ideas and skills learnt is also important*” (TT 02-I, paragraph 21). TT 02 further remarked that the use of a portfolio was not only for assessment but also for following up on the teachers to see what challenges they were facing with regard to implementing the ideas learnt, and also as a reflection on Fundisa for Change training to see if the programme was really working towards achieving its goal and objectives.

... it [portfolio assessment] is important as it is also a form of following up on teachers to see if they are able to implement the ideas got from the training, or not. The assessment gives a kind of a reflection on the training programme because, for example, for the teacher who gets 60% might mean either we are not doing well enough in our trainings or the teacher is struggling to implement the ideas. (TT 02-I, paragraph 30)

MPT 05 indicated that Fundisa for Change programme was indeed following up on them. He said Fundisa for Change was “*always on phone, calling us, 'smsing' [texting] us ...*” (MPT 05-I, paragraph 404). ECT 07 indicated that she needed a more formal follow-up where there would be a meeting for discussing the challenges (ECT 07-I, paragraph 517). She further said: “*I so wish if Fundisa cannot just, after what we've done with them, leave us, at least at Christmas time, we [should] do a follow-up*” (ECT 07-I, paragraph 568). MPT 04 also said that he still had some problems on Taxonomy and would “*love*” to have a follow-up training (MPT 04-I, paragraph 273).

4.3.3.4 Accommodating teachers' inputs

This created a platform where teachers were able to voice the challenges they were facing in their teaching of Biodiversity. TT 01 said that “*in particular the teachers had to say what were the bits of Biodiversity they were struggling with, that they didn't know, and they were struggling to teach*” (TT 01-I, paragraph 17). TT 02 emphasised this idea by saying that,

I think what should be included in the training should come directly from the individual teachers themselves so that these trainings could address their individual needs. The trainings should be open to allow teachers to talk about any issues they have and come up with or suggest ways to help them. These should also allow teachers to open up and talk to each other as it usually happens that there will be some teachers who are more experienced and who can be able to share their expertise with others. (TT 02-I, paragraph 21)

However, TT 02 indicated that even though the effort was made to accommodate teachers' ideas in the training, much still has to be done as there were teachers coming out of the training still showing knowledge gaps.

Of course the teachers are given an opportunity to contribute to the training programme and share their needs, but I think that is not done to the great extent, hence at the end of the trainings, some teachers still indicate difficulties with some concepts. (TT 02-I, paragraph 30)

4.3.3.5 Addressing curriculum delivery challenges faced by teachers in respect of Biodiversity content knowledge, teaching and assessment methods

In the Fundisa for Change Implementation Plan (IP), the main reason for the establishment of Fundisa for Change is stated as follows: *“To enhance transformative environmental learning through teacher education”* (IP, 6).

The notion of capable teachers in Fundisa for Change terms refers to teachers who know their subject content, and therefore are able to select the best methods of teaching and assessing learners. In the Fundisa for Change training, efforts were made to invite curriculum advisors from the Education Districts where the training was held. The purpose of this invitation was for them to provide *“a sort of curriculum articulation and expertise”* (TT 01-I, paragraph 12). TT 02 further noted that *“the training should also be relevant to the curriculum so that the teachers can feel that it addresses the real challenges they are facing”* (TT 02-I, paragraph 21). Reference to the Life Sciences CAPS was made from time to time. In fact the whole training was dependent on the CAPS document because the Biodiversity topic teachers were trained to teach what is in CAPS, and the teachers had been asked to bring the CAPS document with them to the training. ECT 06 confirmed that they even studied the Life Sciences CAPS document at the workshop, which she did not know much about it at that time. She said: *“we were even taught how to use the document [Life Sciences CAPS] ...”* (ECT 06-I, paragraph 219). MPT 05 made the same point that in the training they were taught about *“Using the CAPS document”* (MPT 05-E). MPT 03 was also thankful to have attended

the Fundisa for Change training which dealt with CAPS: “*Most of the information I got there ... it was an eye-opener as far as CAPS is concerned*” (MPT 03-I, paragraph 302).

4.3.3.5.1 Content knowledge

Fundisa for Change provides teachers with environment and sustainability content knowledge during training. As is indicated in the Implementation Plan,

Most importantly ... it [Fundisa for Change] responds to the Department of Basic Education priorities through a focus on the environment and sustainability education content in the Science, Geography, Life Orientation and Technology Curriculum and Assessment Policy Statements across the GET and FET phases (initial focus). (IP, p. 5)

The trained teachers also highlighted the fact that the training helped them in trying to narrow the content gap that they had. MPT 04 indicated that he had a problem naming some plants, but this problem was addressed in the training: “*Some of those plants I didn't even know them even myself. But when I was there the facilitators helped us a lot, because we ... you know we became learners there. We were learning, we were taught everything ... given the names of the plants ...*” (MPT 04-I). The participating teachers did acquire more environment and sustainability content knowledge as displayed in Tables 4.10 to 4.15 in section 4.3.4.1.

TT 02 stressed the fact that one of the major focus areas in Fundisa for Change was the content knowledge because:

Many studies have indicated that there is a gap in teachers' subject content knowledge hence this negatively impacts on the way they teach and on learner performance. This is particularly more common in environmental content knowledge, in this case Biodiversity, as this field is still new. (TT 02-I, paragraph 14)

She further mentioned the sub-topics in Biodiversity that were of importance: “*Some topics that were central in these activities included Taxonomy or Classification, Biomes, Ecosystem Services and Human Impact on the Environment, as these seemed to be the sections where most teachers had problems*” (TT 02-I, paragraph 38).

The training sessions were “*... Biodiversity focused*” as TT 01 indicated (TT 01-I, paragraph 12). He further remarked that “*Know Your Subject was basically the main focus that we started with as people didn't know Biodiversity*” (TT 01-I, paragraph 15).

4.3.3.5.2 Teaching methods

Once teachers know the subject content, they need to find the best ways to teach it. ECT 05 acknowledged that the training helped her improve her knowledge in terms of which teaching methods she could use: *“it [the training] was so useful to me because there were some teaching methods that I did not know ...”* (ECT 05-I, paragraph 206). MPT 01 further indicated how the training improved the way she taught learners: *“from the workshop, I realized just how much learners learn by doing, more than just when I stand in front of the class and I talk and talk and talk. When they do something they actually learn more, so now I try as much as I can to include practical activities”* (MPT 01-I, paragraph 239). MPT 01 also remarked that while they were aware of certain teaching methods,

... we did not know how to implement them in class. It was only after the workshop, that I started understanding that I have to use this method. Then maybe like in one lesson, one topic, I can teach with this method then the following day I can apply this one, so that there should be ... learners should be interested in the lesson because most of the time, we do presentation, presentation (MPT 01-I, paragraph 334)

MPT 04 explained how he might have taught learners the section about the water-holding capacity of the soil had he not attended the Fundisa for Change training: *“What I was going to do it was getting into the class, having the mentality that the learners do know sand soil, you know, maybe I was going to draw some drawings on the board, indicating that this is sand, this is what, not letting the learners to see exactly what we are talking about”* (MPT 04-I, paragraph 241). He further explained the importance of actively involving learners as follows:

... if you talk about for example, the water-holding capacity of ... of the soil, the learners are able to see, because if you put a certain amount of water in the soil, then after sometime you measure that amount as whether the water that is ... that managed to move through the particles down to the container that you are keeping the water in, because the container is the one that is going to give you the exact amount as to ... how much water is being held by what ... by the soil. So it means if you do that practical, the learners, they are going to see rather telling them this is going to happen. (MPT 04-I, paragraph 322)

MPT 05 also highlighted the importance of a learner-centred approach in teaching and learning:

... what I've seen is that when teaching learners such topic as Biodiversity, you don't need to be ... it should not be more of you as an educator, but giving them [learners] the scope, giving them the chance ... it should be learner-centred, so that they can understand things on their own, and they come with their challenges, they work-out, then you fill the gap. You

fill the gaps. By that I think it helped ... it helped learners, rather than keep spoon-feeding them. (MPT 05-I, paragraph 483)

TT 02 expressed the idea that many teachers involved in the training were still using the lecture method to deliver lessons in their classrooms, and as such learners were not participating much in the lessons. She said:

When it comes to the teaching methods, most teachers still use a lecture method when teaching, and this does not really involve learners in the process of teaching and learning. Fundisa encourages teachers to use methods that involve learners more and can make learners experience what they learn. These methods include role-plays and excursions to mention a few, to experience what they learn. It is also important for teachers to be exposed to different types of teaching methods in the Fundisa training, as environmental knowledge is contested and uncertain, thus require open and participatory methods that will engage both the teachers and learners so that they can become critical thinkers who are able to solve environmental issues both at local, national and global level. (TT 02-I, paragraph 16)

ECT 07 noted that different teaching methods can be used in one lesson to make learners understand better. As she said: *“I have learnt that for one lesson you can use more than one teaching method, with the aim that learners should understand what you want them to acquire”* (ECT 07-E). MPT 01 indicated that having attended the training, *“I now fully understand my role as a facilitator in the classroom and how important it is”* (MPT 01-E). MPT 04 also indicated that the training helped him in *“designing activities that will draw the attention of the learners as they are doing them, but they produce the outcome of the lesson”* (MPT 04-E).

4.3.3.5.3 Assessment methods

There was a realisation that some of the participating teachers were struggling with setting question papers that catered for the different cognitive levels, especially high order questions. Some teachers were also not aware of the fact that the teaching method used would influence the type of assessment one would give to the learners, which means that the assessment method is linked to the teaching method. As TT 02 indicated:

In terms of assessment, teachers are trained on how to set different assessment tasks that incorporate all the different cognitive levels as stipulated in CAPS, as it had been observed previously that a lot of tasks that teachers set included more of low order questions and very few high order questions and this disadvantages learners during exams. Teachers are also made aware to align assessment with their teaching methods, and different aspects of assessment: assessment for learning and assessment of learning; and formal and informal

assessment. The compiling and use of rubrics in assessment is also highlighted. In fact we had to do an activity where teachers were given a field activity with questions and were asked to allocate marks to the individual questions and then use the questions to come up with the assessment rubric. That was quite challenging for the teachers to do as they had no idea how to compile a rubric. They also then had to analyze the activity in terms of different cognitive levels. (TT 02-I, paragraph 16)

ECT 06 indicated that she was not aware of the percentages allocated to different cognitive levels when setting a test or an exam until she attended the Fundisa for Change training. She said: *“if maybe you're setting an exam or a test, or any assessment, you have to look for certain percentage, like 40%, those are ... like the Bloom's taxonomy ...”* (ECT 06-I, paragraph 220). TT 01 explained how Fundisa for Change was helping teachers in this regard by saying that *“And one of the new elements that are added to the Fundisa for Change was the differentiation of the percentages of knowledge-based, explanatory-based and higher order questions, and this sort of general framework of exams”* (TT 01-I, paragraph 12). He further indicated that

... it's not just a question of content, it's how the content is delivered, and it's not just a question of content delivery, it's whether the students are able to actually fulfill the assessment tasks, so that they are going to be successful in the exams that they are going to have to do and in progression towards the matric exams. (TT 01-I, paragraph 65)

Participating teachers said the following with reference to how the Fundisa for Change training helped them deal with assessment challenges:

- *“The fact that you have to think about your assessment before and whilst teaching as well as how you must assess; the different levels/types of questions you have to set”* (ECT 04-E).
- *“Using the action verbs that will improve my assessment on the learners, not write down true or false”* (ECT 05-E).
- *“Importance of designing the assessment that will assist the learners to understand better, to develop their critical thinking and to be responsible citizens”* (ECT 06-E).
- *“The fact that assessment helps you to teach, that I should not think of an assessment after a lesson”* (ECT 07-E).
- *“I used to think of assessment after a lesson. Now I have to think of my assessment before I teach. Teaching is determined by what kind of assessment you need to give to learners”* (ECT 07-E).

- *“My assessment should be in line with the assessment requirements outlined in CAPS. Assessment is not just tests but assignments, projects, fieldwork, investigations, practicals. I will be using all of these”* (MPT 01-E).
- *“Now I know various forms of assessment; how and when to assess ...”* (MPT 03-E).
- *“Not to focus on one strategy. I will ensure that I apply the strategies of assessment that I have learnt”* (MPT 04-E).

4.3.3.6 Encouraging establishment of professional learning communities

Fundisa for Change encourages the trained teachers to form groups at their respective clusters where they discuss matters relating to their professional development. These groups are to help them deal with problems they have with regard to delivering the curriculum. As indicated in the Implementation Plan, “it [Fundisa for Change] responds to the Department of Higher Education and Training policy framework that seeks to strengthen Professional Learning Communities (IP, p. 5). TT 02 indicated that *“teachers are also encouraged to form groups in which they share knowledge and help each other out to professionally develop themselves”* (TT 02-I, paragraph 21). The establishment of professional learning communities can be of great help to even new teachers that are starting to teach to deal with the challenges they usually face when starting to work. MPT 01 was one such teacher who had just qualified to become a teacher, and was made to teach Grade 12. As she narrated her first teaching experience, she said:

And [laughing] it was a challenge because I was ... I was only ... I was twenty one [years old] and most of these kids, some of them are of my age and I was like ... I remember the first time I got into class I looked ... I looked at some of them. It was so serious I was like, I will not be able to teach these kids. But then I had to ... I had to learn most things by myself. The school colleagues were not very helpful. (MPT 01-I, paragraph 211)

Teachers had an opportunity to share contacts with each other to create a platform where they could help one another. As MPT 01 indicated *“I actually got contacts from this workshop. Yah I got the contacts, because I still have a lot to learn. There are teachers who have been here for years”* (MPT 01-I, paragraph 359). She further explained the importance of having worked together with some teachers in the training workshop: *“Working with other teachers helped me know a lot of traditional uses of plants”* (MPT 01-E). MPT 02 also added: *“We were able to share ideas ... for helping one another”* (MPT 02-I, paragraph 263). ECT 06 got so motivated working with other teachers that she said: *“I will work with more other Life Sciences teachers to gain knowledge on those aspects that I am not comfortable with”* (ECT 06-E).

4.3.3.7 Running training over a longer period

The two training sessions were run over an average period of three days instead of one day or several hours as shown on the training workshop programmes (see Appendices R and S). TT 02 asserted that “...it is better if the training is run over a longer period than when it is just for a day like Departmental ones [Department of Basic Education], and if the training period has some breaks like the one we ran in Dwesa which had two sessions, unlike the East London one which was only one session” (TT 02-I, paragraph 23). She further explained the importance of a longer training session by indicating that “A longer session also allows teachers to open up and discuss the real problems they face in class as they would have got closer to each other” (TT 02-I, paragraph 26).

TT 01 said,

... if you're going to make change to happen and if you're going to get teachers to get deeper understanding of things, one needs months, rather than days. So the ... spacing of something not just a once off, you know, come four or five hours and then you got it ... that's difficult (TT 01-I, paragraph 58)

He further said: “So I think you need three to four sessions to build a sort of professional learning community discourse ...” (TT 01-I, paragraph 58). The following is what the participating teachers said about the duration of the Fundisa for Change training:

- “Three days” (ECT 06-I, paragraph 258)
- “It was three .. three days” (ECT 07-I, paragraph 341)
- “It was four days” (MPT 03-I, paragraph 310)
- “We had enough time ...” (MPT 04-I, paragraph 218)
- “I think it was three. It was ... three days ... Friday, Saturday ... Friday, Saturday, and Sunday” (MPT 05-I, paragraph 384)

The above responses indicate that Fundisa for Change training sessions are run over a number of days. They were not held for a few hours or a single day. This seemed important to the teachers.

4.3.4 Teachers' experiences about Fundisa for Change continuing teacher training programme

4.3.4.1 Biodiversity content knowledge

The participating teachers were asked the following question to find out if the training had any impact on their knowledge of the identified concepts.

How would you rate your knowledge before and after Fundisa for Change training in terms of the following concepts: Ecosystems, Biodiversity, Taxonomy, and Human-environment relationships?

Tables 4.12 to 4.15 display the responses obtained from the workshop evaluation forms that were filled in immediately after the training workshop. The responses represent the teachers' knowledge of the Biodiversity terms after the workshop.

Table 4.12: Workshop evaluation responses on Ecosystems

Concepts:	Strong, completely adequate	Not bad, but needs improvement	Weak, needs strengthening
Ecosystems	Before <input type="checkbox"/> After <input checked="" type="checkbox"/>	Before <input type="checkbox"/> After <input checked="" type="checkbox"/>	Before <input type="checkbox"/> After <input checked="" type="checkbox"/>
	MPT 03, MPT 01	ECT 07, ECT 06, MPT 04, MPT 02, MPT 05, ECT 05	ECT 04
Please comment on your rating:	ECT 07: <i>"I have not been teaching Grade 10 and 11 for years, which have more of these concepts"</i> (ECT 07-E). ECT 06: <i>"I just taught Life Sciences. The knowledge that I have is from my experiences from the university, so I am not sure about any latest discoveries in recent years"</i> (ECT 06-E). ECT 05: <i>"I gained a lot on plants and animals being dependent on each other; there is an interrelationship between the living"</i> (ECT 05-E). ECT 04: <i>"Due to the fact that I am not currently involved in Life Sciences, that affects my understanding"</i> (ECT 04-E). MPT 05: <i>"I do understand an ecosystem as interaction of different organisms in bringing about life"</i> (MPT 05-E). MPT 01: <i>"As a Grade 8 educator as well, ecosystem is one concept I have already dealt with, with my learners"</i> (MPT 01-E).		

Table 4.12 indicates that two teachers were confident enough about the knowledge on Ecosystems that they gained in the training workshop, while six teachers felt they needed more knowledge on the concepts. ECT 04, however, felt that the training did not do much as she still felt weak in terms of the knowledge on Ecosystems even after the training. However, there are several contextual factors that contributed to some of the responses from the teachers, one of which being that not all the teachers were Life Sciences teachers as exemplified by ECT 04. Some teachers were Life Sciences teachers but they were not teaching the particular Grades in which these topics are dealt with. Most of the teachers indicated that they still needed more knowledge on Ecosystems.

Table 4.13: Workshop evaluation responses on Biodiversity

Concepts:	Strong, completely adequate	Not bad, but needs improvement	Weak, needs strengthening
Biodiversity	Before <input type="checkbox"/> After <input checked="" type="checkbox"/>	Before <input type="checkbox"/> After <input checked="" type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>
	MPT 05, MPT 03, MPT 01	ECT 07, ECT 06, ECT 05, ECT 04, MPT 04, MPT 02	
Please comment on your rating:	ECT 07: <i>"I was not involved"</i> (ECT 07-E). ECT 05: <i>"To me it was not clear, but now I have gained something but need to be improved"</i> (ECT 05-E). ECT 04: <i>"Not being in Life Sciences affects my knowledge"</i> (ECT 04-E). MPT 05: <i>"I know it as a wide range/variety of life forms"</i> (MPT 05-E). MPT 01: <i>"Biodiversity was divided into modules in the university, Botany and Zoology which I did in three years"</i> (MPT 01-E).		

The table above indicates that six of the nine teachers still felt that more could be learnt in Biodiversity even after the training. This could be an indication that these teachers had very little knowledge on Biodiversity prior to the training workshop. Only three teachers indicated that their knowledge was strong and completely adequate after the training. Even though ECT 04 still felt she needed more improvement on this concept, this is what she said after the training: *"I was not exposed to the Biodiversity content, but this course, I feel well equipped and even ready to start teaching Biodiversity"* (ECT 04-E).

Table 4.14: Workshop evaluation responses on Taxonomy

Concepts:	Strong, completely adequate	Not bad, but needs improvement	Weak, needs strengthening
Taxonomy	Before <input type="checkbox"/> After <input checked="" type="checkbox"/>	Before <input type="checkbox"/> After <input checked="" type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>
	MPT 01	ECT 07, ECT 06, MPT 04, MPT 02, MPT 05, MPT 03, ECT 05, ECT 04	
Please comment on your rating:	ECT 07: <i>"I was not involved"</i> (ECT 07-E). ECT 05: <i>"Science needs systematic way of teaching it; needs strengthening"</i> (ECT 05-E). ECT 04: <i>"Do understand it, just need improvement in being able to use it in assessment situations"</i> (ECT 04-E). MPT 05: <i>"I understand it as a classification of species according to their generic group"</i> (MPT 05-E). MPT 01: <i>"I did Taxonomy on my first year (at university) when introducing Biodiversity"</i> (MPT 01-E).		

Table 4.14 also shows one teacher who had enough knowledge on Taxonomy after the training. Eight of the nine teachers still indicated that they wanted to further improve their knowledge on Taxonomy. Taxonomy seemed to be a concept which most teachers struggled to understand.

Table 4.15: Workshop evaluation responses on Human-environment relationships

Concepts:	Strong, completely adequate	Not bad, but needs improvement	Weak, needs strengthening
Human-environment relationships	Before <input type="checkbox"/> After <input checked="" type="checkbox"/>	Before <input type="checkbox"/> After <input checked="" type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>
	MPT 04, MPT 05, MPT 01	ECT 07, ECT 06, MPT 03, MPT 02, ECT 05, ECT 04	
Please comment on your rating:	ECT 07: <i>“I was not involved”</i> (ECT 07-E). ECT 05: <i>“Not bad but need improvement”</i> (ECT 05-E). ECT 04: <i>“This is a broad unit to learn about, know and master, so I still need a lot of engagement especially with the new developments”</i> (ECT 04-E). MPT 05: <i>“The interfering of humans to environmental issues/processes as well as relationship among humans and environment”</i> (MPT 05-E). MPT 01: <i>“These are concepts we do not only study but also observe and live daily”</i> (MPT 01-E).		

With regard to Human-environment relationships, three teachers were adequately equipped with the knowledge by the end of the training workshop, while six teachers still wanted to improve their knowledge on this concept.

From these workshop evaluation responses, there was no participating Eastern Cape teacher who came out of the training with strong and completely adequate knowledge on the concepts. Only participating teachers from Mpumalanga seemed to achieve this. Even so, the number of these teachers who showed strong knowledge in the concepts was still low, ranging from one to three. All the participating teachers from Eastern Cape, including MPT 02 from Mpumalanga, which is a total of five out of nine, indicated that their knowledge on all the concepts was not bad, but still needed improvement, after the training. MPT 03 still needed to improve her knowledge on Taxonomy and Human-environment relationships but had strong knowledge on Biodiversity and Ecosystems. MPT 04 needed improvement in knowledge on Ecosystems, Biodiversity, and Taxonomy, but he felt he had strong knowledge on Human-environment relationships. MPT 05 said he still needed more knowledge on Ecosystems and Taxonomy after the training, but said he had strong knowledge on Biodiversity and Human-environment relationship. In all cases, except for MPT 01, the

participating teachers seemed to have lacked some knowledge on all the stated concepts which they were able to narrow during the training workshops.

Table 4.16: Summary of the interview responses on the environmental concepts

Concepts:	Strong, completely adequate		Not bad, but needs improvement		Weak, needs strengthening	
	Before <input type="checkbox"/>	After <input checked="" type="checkbox"/>	Before <input checked="" type="checkbox"/>	After <input checked="" type="checkbox"/>	Before <input checked="" type="checkbox"/>	After <input type="checkbox"/>
Ecosystems						
		ECT 06, MPT 01, MPT 03, MPT 05, MPT 02, ECT 07	MPT 01, MPT 03, MPT 04, MPT 05, MPT 02, ECT 07	ECT 04, ECT 05	ECT 04, ECT 05, ECT 06	
Biodiversity	Before <input checked="" type="checkbox"/>	After <input checked="" type="checkbox"/>	Before <input type="checkbox"/>	After <input checked="" type="checkbox"/>	Before <input checked="" type="checkbox"/>	After <input type="checkbox"/>
	MPT 01, MPT 05	MPT 01, MPT 02, MPT 05, ECT 07	ECT 07	ECT 04, ECT 05, ECT 06, MPT 02, MPT 03, MPT 04	ECT 04, ECT 05, ECT 06, MPT 03, MPT 04	
Taxonomy	Before <input checked="" type="checkbox"/>	After <input checked="" type="checkbox"/>	Before <input type="checkbox"/>	After <input checked="" type="checkbox"/>	Before <input checked="" type="checkbox"/>	After <input type="checkbox"/>
	MPT 01, MPT 05	MPT 01, MPT 05, ECT 07	ECT 07	ECT 04, ECT 05, ECT 06, MPT 02, MPT 03, MPT 04	ECT 04, ECT 05, ECT 06, MPT 02, MPT 03, MPT 04	
Human-environment relationships	Before <input checked="" type="checkbox"/>	After <input checked="" type="checkbox"/>	Before <input checked="" type="checkbox"/>	After <input checked="" type="checkbox"/>	Before <input checked="" type="checkbox"/>	After <input type="checkbox"/>
	MPT 01, MPT 05	ECT 04, ECT 07, MPT 01, MPT 05	ECT 04, ECT 06, ECT 07, MPT 02	MPT 02, MPT 03, MPT 04, ECT 05	ECT 05, MPT 03, MPT 04	

Though the responses in Table 4.16 differ slightly from the responses on the evaluation forms, an improvement in knowledge in the stated environmental concepts is observed. For example, ECT 06 had little knowledge on Ecosystems, but at the end of the training she had strong and adequate knowledge on this concept. She said “*they told us about the provisions of the Ecosystems. But there was something new that I learnt about the Ecosystems*” (ECT 06-I, paragraph 297). Taxonomy and Biodiversity seem to be the concepts most teachers were struggling with, and even after the training, teachers still wanted to have more knowledge on them. However, while most teachers had

difficulties with these concepts, MPT 01 was an exception as she indicated that the training did not have much impact on her knowledge of Biodiversity, Taxonomy and Human-environment relationships as she studied them at the university and was only six months into her job and fresh from the university. Teachers seemed to have had little challenge in understanding Ecosystems and Human-environment relationships as less than half of them were weak in these concepts before the training, and after the training, their knowledge had improved.

Table 4.17: Topics in which teachers acquired new knowledge in the training

Topic	Participant and source of information
Biomes	ECT 04-I, MPT 05-I, MPT 04-E
Ecosystems	ECT 04-I, ECT 05-I, ECT 06-I, ECT 07-I, MPT 01-I, MPT 02-I, MPT 03-I, MPT 04-I, MPT 05-I, MPT 02-E, MPT 05-E, ECT 06-E, ECT 07-E
Taxonomy	ECT 04-I, ECT 05-I, ECT 06-I, ECT 07-I, MPT 02-I, MPT 03-I, MPT 04-I, MPT 04-E, ECT 06-E, MPT 01-E
Biodiversity	ECT 04-I, ECT 05-I, ECT 06-I, ECT 07-I, MPT 02-I, MPT 03-I, MPT 04-I, MPT 02-E, MPT 03-E, ECT 04-E
Human-environment relationships	ECT 04-I, ECT 05-I, ECT 07-I, MPT 02-I, MPT 03-I, MPT 04-I, ECT 07-E, MPT 03-E

(Source of information: I = Interview; E = Evaluation form)

The teachers were asked to indicate the topics in which they acquired new knowledge during the Fundisa for Change training. All nine indicated Ecosystems, followed by eight who indicated Taxonomy, then seven in Biodiversity, six in Human-environment relationships and three in Biomes. MPT 01 indicated that even though she was confident about Taxonomy, she gained new knowledge on “*identifying plant species, knowing their botanical names and their traditional uses*” (MPT 01-E). The training seemed to have been of great help to some teachers, as ECT 04 stipulated: “*I had no prior knowledge about Biodiversity, so anything was welcomed*” (ECT 04-E). She further indicated that “*it [Fundisa for Change training] sort of opened a lot of doors for me about the Ecosystems ...*” (ECT 04-I, paragraph 231). ECT 05 added that “*Fundisa for Change enhanced my knowledge ...*” (ET 05-I, paragraph 372). ECT 06 highlighted the reason why the training was important to her:

... my foundation for Life Sciences is not that ... I would say it's not that good because ... like you know the content, but when you relate to something that is happening really, you ... you ... I've got a problem with that, I would say. So it does have an impact on ... on ... even on how you teach because you've got this big gap. (ECT 06-I, paragraph 165)

4.3.4.2 Teaching methods

The table that follows shows the teaching methods commonly used by the participating teachers.

Table 4.18: Commonly used teaching methods in Life Sciences by the participants

Participant	Commonly used teaching method						
	Field-work	Group-work (discussions)	Practical work	Teacher-centred (telling, narrative, presentation)	Question-and-answer	Textbook	Discovery
ECT 04		✓(I, E)	✓ (I)	✓ (I, E)			
ECT 05		✓ (I)		✓ (I)	✓ (I, E)	✓ (I)	
ECT 06				✓ (I, E)	✓ (I)		✓ (E)
ECT 07		✓(I, E)		✓ (I, E)			
MPT 01	✓ (E)		✓(I, E)	✓ (I)			
MPT 02				✓ (I)		✓ (I)	
MPT 03		✓(E)		✓ (I)			
MPT 04		✓(I, E)		✓ (E)			
MPT 05	✓ (I)			✓ (I)	✓ (I)		

(Letters in brackets represent the source of the answer: I = Interview; E = Evaluation form)

The table above indicates that all the participating teachers were using teacher-centred approaches to teaching. The other method which appeared to be used by many teachers was group-work, followed by a question-and-answer method. Other methods seemed to be used by very few teachers.

Table 4.19: New teaching methods learnt by the participants

Participant	New teaching method						
	Fieldwork (excursions, field-trips)	Case studies	Investigations	Solitaire	Role-play	Learner-centred (group-work)	Round-robin
ECT 04	✓ (I)						
ECT 05	✓ (E)			✓ (E)	✓ (E)	✓ (E)	
ECT 06	✓(I)						✓ (E)
ECT 07	✓ (E)						
MPT 01	✓ (I)		✓ (I)				
MPT 02	✓ (E, I)					✓ (E, I)	
MPT 03		✓ (E)					
MPT 04						✓ (I)	
MPT 05						✓ (I)	

(Letters in brackets represent the source of the answer: I = Interview; E = Evaluation form)

The above table shows that most teachers indicated fieldwork as the new teaching strategy they learnt about, meaning that they might not have been using it much. This was followed by learner-centred methods. As MPT 02 indicated “we didn't know much about fieldwork. It's something that we didn't care about. The only thing that we will think about is the textbook, and then it is important

to take learners outside the classroom” (MPT 02-I, paragraph 179). MPT 01 stressed the use of fieldwork and investigation in teaching learners environment and sustainability content by saying that “We usually use presentations. But when coming to environmental studies, fieldworks are also important and investigations as well” (MPT 01-E). Commenting on the new learner-centred methods she was introduced to, ECT 04 said: “It is important to consider your learners as the centre of the learning by giving them the opportunity to reveal what they know about the topic. Not that it is only you who knows” (ECT 04-E).

Teachers in the training were exposed to a number of teaching methods in the teaching of Biodiversity as ECT 07 indicated: “Yoh, there was a lot of teaching methods that were introduced there” ECT 07-I, paragraph 453). It was not only that there were many methods learnt, as ECT 04 confirmed: “The methods of teaching and tackling Biodiversity were well covered ...” (ECT 04-E). MPT 01 also learnt the importance of teachers testing some teaching methods before trying them with learners, so that they could know their challenges and how to deal with them beforehand. She said: “We need to go out and experience these things ourselves, and then when it was my turn to take the kids out, it was much easier because I was already aware of how it is done” (MPT 01-I, paragraph 171).

4.3.4.3 Assessment methods

The participating teachers were asked to indicate which methods of assessment they usually used in their classes, and which new ones they had learnt from the training, and they gave different ideas. The methods they mentioned do not necessarily mean that they were the only ones used, as some teachers mentioned only one method. There are certain different assessment methods that the CAPS specify for teachers to use. The assessment methods mentioned here are additional to those specified in CAPS. The following table indicates the assessment methods teachers commonly used in class.

Table 4.20: Commonly used assessment methods in Life Sciences by the participants

Participant	Commonly used assessment method							
	Class-work	Research / Project	Experiment / practical	Test	Assignment	Work-sheets	Case studies	Home-work
ECT 04								
ECT 05	✓ (E)	✓ (E, I)	✓ (E, I)	✓ (E)				
ECT 06			✓ (I)	✓ (E, I)	✓ (E)	✓ (E)		
ECT 07	✓ (E, I)		✓ (E)	✓ (E)			✓ (E, I)	
MPT 01			✓ (I)	✓ (E, I)			✓ (E)	
MPT 03	✓ (E, I)	✓ (I)	✓ (I)	✓ (I)	✓ (I)			✓ (E)
MPT 04	✓ (E)		✓ (E, I)	✓ (E, I)	✓ (I)			
MPT 05			✓ (E)	✓ (E)				

(Letters in brackets represent the source of the answer: I = Interview; E = Evaluation form)

The above table shows that tests are the most common method of assessment among the participants, followed by the use of practicals and also class-work. Homework and use of work-sheets seemed to be the least used methods by the participants. MPT 01 explained why she gave learners informal tests: *“I give a lot of informal class-tests, at least once a month as well as practicals. I use self-assessment and peer-assessment informally a lot to help in realising their mistakes”* (MPT 01-I). The participating teachers used different assessment strategies, ranging from two to six per teacher.

Table 4.21: New assessment methods learnt by the participants

Participant	New assessment method		
	Practicals	Case studies	Work-sheets
ECT 06	✓ (I)		
ECT 07	✓ (I)		
MPT 01		✓ (I)	
MPT 03	✓ (I)	✓ (I)	
MPT 05			✓ (I)

(Letter in brackets represents the source of the answer: I = interview)

Five teachers indicated that they had gained new knowledge on the assessment methods shown on the table above, with more teachers referring to the use of practicals. ECT 06 confirmed that she did not know how to use practicals, but she had to give them as it was required for portfolio assessment: *“I didn't know how to teach like any pracs [practicals], in Grade 10s, but I had to plan something because it was required by the assignment ...”* (ECT 06-I, paragraph 353). Before attending Fundisa for Change training, ECT 07 was not aware that one had to identify the skills to be addressed by the practical before developing it and giving it to the learners. As she indicated: *“I never ... thought of ... the thing of skills ... it was emphasised there that whenever you are giving a test or a practical, you must have skills that they have to gain”* (ECT 07-I, paragraph 474). She went on to mention some of those skills as *“listening”* (ECT 07-I, paragraph 475) and *“reading”* (ECT 07-I, paragraph 484). MPT 01 also confirmed having learnt something new on assessing human impact on the environment. She said: *“I did learn that case studies can also be used to assess, especially when dealing with human impact on the environment”* (MPT 01-I, paragraph 262). ECT 04 and ECT 07 raised the point that the Fundisa for Change training changed the way they were thinking about assessment, that it came after teaching, while in fact the assessment method determines the kind of teaching method one uses (ECT 04-E and ECT 07-E) (refer to section 4.3.3.5.3).

4.3.4.4 Conducting the training

The table that follows lists the words used to describe the trainers and the general organisation of the training

Table 4.22: Words used to describe the trainers, presentations and the trainings in general

Participant	Descriptive words used		
	Trainers	Presentation	Overall training
ECT 04	Passionate (I); well prepared (E); enthusiastic (E)		
ECT 05	Experts (E); well prepared (E)		
ECT 06	Thoroughly prepared (E)	Interesting (E)	
ECT 07	Knowledgeable (I); Clear (E); well prepared (E)	Good (I); interesting (I)	Good (E, I); active involvement (E); interesting activities (E)
MPT 01	Very friendly (E); very well prepared (E); professional treatment (E); offering assistance (E)		Enjoyable (E)
MPT 02			All perfect (E)
MPT 03	Well informed (I); impressive (I)		Fruitful (I)
MPT 04	Passionate (I); well prepared (E)	Interesting (E)	Worthwhile (I)
MPT 05	Perfect (E); more than prepared (E); friendly (E)		

(Letters in brackets represent the source of the answer: I = Interview; E = Evaluation form)

Most participating teachers commented very positively about the trainers, describing them as very friendly, helpful, well prepared, knowledgeable, thoroughly prepared, passionate and professional. As ECT 07 indicated: *“The course was good. The facilitators were clear about what they were delivering to us. They were well prepared. They made us to be actively involved. They had a lot of interesting activities”* (ECT 07-E). MPT 01 added that *“The facilitators were very friendly. They were very well prepared and treated us like the professionals we are. They did their best to assist us a lot and made the course enjoyable”* (MPT 01-E). She went on to say: *“I have learnt a lot in this workshop”* (MPT 01-E). The teachers were also appreciative of the general running of the training and the presentations made. The presentations were mostly described as interesting while the trainings were described to have been perfect, enjoyable, good and active. As MPT 02 indicated: *“It was all perfect”* (MPT 02-E). ECT 07 further added that *“everything was ... was good. Presentations were good ... people who were talking there they knew what they were talking about and they made the subject itself also to be so interesting”* (ECT 07-I, paragraph 489-490). MPT 03 also indicated the importance of the training: *“It was very fruitful because since I said I never attended any CAPS [training]”* MPT 03-I, paragraph 302. MPT 04 echoed the same sentiment by saying: *“to be honest, I won’t lie, this workshop was worthwhile”* MPT 04-I, paragraph 288).

The issuing of workshop materials was also greatly welcomed by the teachers. These materials served as reference materials in the preparation of their Biodiversity lessons. This came at the right time, when teachers were being introduced to the new curriculum and facing the challenge of shortage of teaching and learning materials. As TT 02 indicated: *“Fundisa provides resources that teachers can use to help them improve their subject content knowledge, teaching methods and assessment strategies”* (TT 02-I, paragraph 14). She also observed that *“the distribution of teaching and learning material or resources was much appreciated by the teachers as it seemed to be a challenge for them to gather more resources”* (TT 02-I, paragraph 39). MP 04 also confirmed having been given resources: *“a lot of books were given, that talk about Biodiversity”* (MPT 04-I, paragraph 404). ECT 06, commenting on the booklets she got, said: *“I use them even to prepare lessons, or maybe to use ... like the method that is suitable. You know the different methods, but you don't know the one that is suitable for a certain topic”* (ECT 06-I, paragraph 468). Not only booklets were handed out, but also discs on Biodiversity and Fundisa for Change, as MPT 05 confirmed: *“they did give us the information from the discs, the prepared disc was on Fundisa, it was having information, based on Biodiversity, Biomes, the topics that ... they were catering [for] ...”* (MPT 05-I, paragraph 246). ECT 05 also indicated having got the training presentations and information discs during the training (ECT 05-I, paragraph 339). The following is what some of the teachers said about the Fundisa for Change materials:

- *“Each material has something that you can learn and use in your teaching practice”* (ECT 04-E).
- *“These materials help us and motivate us to work; more knowledge about how to teach Biodiversity to our learners”* (ECT 05-E).
- *“I will be able to work with different resources that will help me to have a broader understanding than the book”* (ECT 06-E).
- *“The books are very good. The book on Teaching Biodiversity gives us more information on wetlands, a new topic in Grade 11. The extracts can help us to improve the assessment and skills my learners can acquire”* (ECT 07-E).
- *“Some books ... are very good. Yes they helped me in understanding most of the things on Biomes, because there are many ... books that I have”* (ECT 07-I, paragraph 378).
- *“The book on teaching Biodiversity is very insightful; Methods and Strategies booklet is a must-have and the Enviro-facts booklet(s) are heaven sent”* (MPT 01-E).
- *“When we were at the ... the workshop, there were some materials that were given”* (MPT 01-I, paragraph 335).
- *“We were given the material”* (MPT 02-I, paragraph 192).
- *“Very useful”* (MPT 02-I, paragraph 195).

- *“Very helpful, at least I know where to find some of the methods and how to use each of them which will make my teaching very effective and easy to apply”* (MPT 03-E).
- *“I do actually consult them [books] ... as far as Biodiversity is concerned, because most of the books that were given were on Biodiversity”* (MPT 03-I, paragraph 361).
- *“They [books] contain most of the information that we are dealing with in our sessions”* (MPT 04-E).
- *“We were given a lot of books”* (MPT 04-I, paragraph 359).
- *“The different sources will help us get different views on the content”* MPT 05-E).

The quotations presented above indicate how the participants were appreciative of the way the training sessions were organised and run, and the resource materials they received at the training sessions.

4.3.4.5 General experiences

The training teachers attended helped them develop professionally. This is because the content knowledge of the teachers on environmental concepts had improved. Teachers also learnt more about the different teaching methods they could use in their Biodiversity lessons. They further learned new ideas about assessment which will improve the way they assess learners. As TT 02 indicated: *“Teachers became more confident now that they had more content knowledge, and skills on teaching and assessment had improved, and in that way they could realize their personal and professional identities”* (TT 02-I, paragraph 36). She further said: *“Some of them told me that they now look at nature or environment in a different way from the time before they attended the training”* (TT 02-I, paragraph 36). This is the same sentiment echoed by MPT 01 when she said:

... after the workshop, I found myself appreciating Biodiversity more, because you know the black communities that we grow up in, a plant is just a plant. It's something you can just chop it up any time, and an animal is just an animal. You can run into a frog and kick it for no reason. I ... I found myself appreciating it more, and I ... I passed that on to the learners. (MPT 01-I, paragraph 289)

From a personal point of view, MPT 05 agreed that the training impacted positively on him. He said: *“it had great impact on me, generally speaking”* (MPT 05-I, paragraph 423).

Teachers had also learnt that learners must always be in the forefront when planning and presenting the lessons. ECT 04 indicated how they were trained by Fundisa for Change:

... whatever you need to do with your own learners, then that's what they teach you to do, so that when you go back to school, you exactly know what is it that you need to do with your own learners, how you can make them interested in this lesson, how you can make them understand. Rather than just preaching to them, let them touch and be part of the practical side of it which ... which I feel will make learners understand more. (ECT 04-I, paragraph 193)

TT 02 added that: *“Teachers felt that whatever they do, they owe it to the students, because in the end it is the students who have to benefit”* (TT 02-I, paragraph 36). It was also emphasised that learners’ prior knowledge is important, and that this knowledge should always be gauged at the start of the lesson, as this would shape how the lesson develops (ECT 04-E; ECT 05-I, paragraph 481 & MPT 04-I, paragraph 302).

One other aspect that teachers learnt in the training was that of improvising to tackle the problem of a shortage of teaching and learning materials, or even lack of funds when it came to taking learners on a field trip. During the training, examples were given where teachers could use whatever resources were at hand to teach certain topics. The most talked-about example was that of using shoes or books to start teaching Taxonomy. Several teachers commented very positively on that example. ECT 07 said: *“you know, to see that you can even do Classification with the books, you can just take all these books and put them and that ... Yoh, that was so interesting”* (ECT 07-I, paragraph 415). MTP 04 was very excited to have used shoes to illustrate classification: *“I remember we did classification. You know we even pulled off our shoes, classifying them, you know. You know it was interesting, because even at the university we are told that your lessons should be enthusiastic ...”* (MPT 04-I, paragraph 289). The CAPS document also highlights the importance of improvising:

If equipment is limited, teachers should be encouraged to improvise. The same skills can be developed using improvised equipment. Moreover, if there are no alternatives, it is more effective for teachers to demonstrate an investigation than to not do investigations at all due to lack of equipment. (LS-CAPS, p. 19)

ECT 05 was also happy to realise that one does not have to always take learners to distant places when organising fieldwork. Local areas such as the school surroundings might be used to save time and money. As she said in terms of fieldwork, one can organise it with the idea of *“not necessarily going out, but you can do it within the school premises”* (ECT 05-E). ECT 04 also indicated that in

the Fundisa for Change training, they learnt that to effectively build up the learners' knowledge, *“you use the Environment around you”* (ECT 04-I, paragraph 266).

4.4 Conclusion

The results from the interviews, workshop evaluation forms and document analysis have been discussed in this chapter. The Biodiversity content as represented in the Life Sciences CAPS document was presented. The way the Fundisa for Change teacher training is structured to help teachers teach the Biodiversity content was also presented. The characteristics of Fundisa for Change teacher training programme and the teachers' experiences of Fundisa for Change training programme were discussed. The chapter explored the Biodiversity content in CAPS, how Fundisa for Change programme trains teachers to teach and assess this content and the features that contributed to making the Fundisa for Change training programme effective. Fundisa for Change Biodiversity training programme activities are designed from the Life Sciences CAPS document, and the programme portrays the qualities of an effective teacher professional development initiative. The training improved the participants' teaching practice. The next chapter describes the Biodiversity lessons presented by the participating teachers through the use of the theory of practice architectures.

CHAPTER 5: THE PRACTICE ARCHITECTURES OF TEACHING BIODIVERSITY

5.1 Introduction

This chapter uses the theory of practice architectures to explain and analyse the Biodiversity lessons conducted by the participating teachers for their portfolio assessment. This analysis will help establish factors that enabled and constrained the teaching of the lessons in question. Eight lessons have been analysed using the theory of practice architectures framework. I was not able to observe the lessons for the reasons mentioned in sections 2.5 and 3.8. The analysis is mainly based on the interviews and on the portfolio work the teachers submitted as part of their assessment. In the portfolios are the lesson plans, teacher reflections on the lessons and the learner assessment tasks. Photographs of the lessons were also included in the portfolios but I did not attach them to this thesis for the reason that I did not get the permission to do so. Other relevant material such as CAPS documents and the interview transcripts are also used to add to the discussions. The chapter is the first step of Phase 2 of the abductive data analysis process. The second step is discussed in the next chapter.

The lessons have been treated as individual cases because the contexts of the schools are different and even some of the topics taught differ due to the broad nature of Biodiversity as a topic. However, there are some ideas that might apply to all schools, such as the use of English Language as an instructional language, and what CAPS as a policy, requires teachers to do. A conclusion is presented at the end of the chapter.

5.2 Teaching Biodiversity seen through the practice architectures'

theoretical lens

This theory was introduced and explained in section 2.2, and the analytical framework used here is attached as Appendix I. This provides an abductive analysis of the results, in which theory is used to analyse data. Practice architectures analysis involves looking at the sayings (the language and ideas), doings (activities, space, materials and time) and relatings (relationships) in the teaching of Biodiversity by each teacher, and the practice architectures (enabling and constraining factors) shaping the lesson. The practice in question here is the teaching of Biodiversity.

5.2.1 Analysis of ECT 05 lesson on Classification

The main aim of the lesson, as stipulated by the participant, was for the learners to acquire scientific knowledge. The teacher focused on the terminology used in classification and provided learners with pictures of various organisms to work with. The issue of human impact on the environment was also explored. The purpose of the lesson was influenced by the practice landscape, a key feature being large classes. As can be seen from Table 5.1 below, there were some definable sayings which related mainly to specialist terms in the lesson. In terms of the doings, evidence in the table below shows that the teacher used a teaching strategy that firstly mobilised learners' existing knowledge, and then introduced new terms. She also used graphic approaches in the teaching. However, the doings or teaching practices were constrained by the material-economic arrangements, especially the lack of adequate laboratory resources, basic furniture and a library. In terms of relatings, it can be seen in Table 5.1 below that the large class size caused a disruptive learning environment in which the teacher then only worked with a smaller group. The socio-political arrangements of the school could not mediate this disruption, with the consequence that only a small group of learners were taught, even though the teacher was using good methods and she herself had learned a lot from the lesson.

Table 5.1: Practice architectures of teaching Classification

Elements of practices <i>Project</i>	Practice architectures in the site <i>Practice landscape</i>
The purpose of the lesson was to make learners able to classify organisms. They could use a variety of ways such as common names or places where the organisms were found to classify them.	The school had an average of 60 learners per class. The participant was not a regular Life Sciences teacher at the school. She attended the training to represent the school as the Life Sciences teacher could not attend. She taught Geography. But she indicated that she also studied Biology, so she regarded herself as a Life Sciences teacher though she never taught Life Sciences before. She had a Senior Teacher's Diploma (STD) and an Advanced Certificate in Education (ACE).
	The lesson that she presented was a Grade 10 lesson on Classification for a duration of one hour. She indicated that generally the school had large numbers of learners in classrooms and this resulted in less control of the learners.

Sayings

Some terms such as Taxonomy, Classification, domestic animals, wild animals, Monera, Protista, Fungi, Plantae, Animalia, Phylum, Class, Order, Genus, Species and common names of some animals were introduced.

These are the scientific terms which helped improve the learners' scientific language skills.

Doings

The teacher introduced the lesson by asking the learners to identify domestic and wild animals from the pictures of different animals given to them. The learners were further asked to group them according to their common names such as dog, cat, zebra, lion and so on, from the first two groups of domestic and wild animals that they formed.

The teacher then introduced the learners to the history of classification system, the Whittaker five kingdom system (Monera, Plantae, Animalia, Fungi and Protista) and Linnaeus levels of classification (Phylum, Class, Order, Genus and Species). She also gave learners an activity on Linnaeus classification system.

Several pictures taken during the lesson had been provided. One picture shows the teacher in the class introducing the lesson to the learners. The other pictures show learners outside the class standing in groups around certain plants. The teacher indicated that they were using the knowledge gained from the class to name the plants by using the binomial system. This means that a lesson should have been conducted during which the learners were introduced to the Binomial system of naming organisms. She indicated that it

Cultural-discursive arrangements

The medium of instruction at the school is English, and the teacher together with most learners at the school speak IsiXhosa as their Home Language. The teacher in this case is the one who has the scientific knowledge expected to be instilled in learners.

With regard to code-switching, the participant indicated that one can explain concepts in Xhosa but English must play a bigger role because the learners write their assessment tasks in English. She further indicated that: "*Some of them [learners], if you ... always translate in Xhosa, even your examples in Xhosa, they will write them on the exam paper in Xhosa ...*" (ECT 05-I, paragraph 244).

Material-economic arrangements

The resources available at school to facilitate the process of teaching and learning include a projector, some charts.

The school does not have a library. The science laboratory did not have equipment and it was used as a class. She indicated that she did not have reference books other than the book samples got from the publishers. She also indicated that there were learners who did not have textbooks and they ended up photocopying materials for learners from time to time.

The teacher said that the school did not have a lot of resources. They tried to run fundraising campaigns but all were unsuccessful because of the low socio-economic status of the community around the school.

The lesson was conducted in a Grade 10 class which had 76 learners, but not all the learners took part.

The school did not have enough furniture for the learners, so much that during the lesson, there were some learners who were standing.

The methods that the teacher used in this lesson were question-and-answer, group discussion, presentation and the use of a textbook.

was easy for the learners to name the plants as they were known to them.

Relatings

The teacher complained that some learners were disruptive during the class, so much that they even decided to move out of the class. She ended up using a smaller group of learners and not the whole class which had 76 learners. Commenting on the behaviour of the learners, she said “*most of the time, other learners did not care about the lesson. They took their books and went home, but I tried to involve a small group ...*” (ECT 05-I, paragraph 116). She attributed this behaviour to the fact that she was not teaching them Life Sciences but this could also be linked to the big class size. In any case the lesson went on with the group that was left.

Dispositions (habitus)

Understandings: The scientific terms and concepts that were discussed in the lesson improved the learners’ scientific language skills. This also improved their knowledge of scientific terms. They also understood the scientific way of classifying and naming organisms. This is due to the fact that the learners were able to carry out the activity given to them.

Skills: Listening skills, scientific language skills, scientific way of classification and naming and communication skills improved. These skills were more developed as learners were engaged in the lesson through talking to each other in their groups, and to the teacher.

Values: Since the learners were also working in groups, values such as respect for each other, appreciating nature and tolerance. These values came into the fore during the lesson.

Social-political arrangements

These include school regulations, CAPS policy, code of conduct for learners and teachers. CAPS clearly tells the teacher what to teach. The rules and regulations are general rules governing what happens in schools and create a conducive teaching and learning environment (refer to 5.2.9 for more clarification).

Practice traditions

The teacher indicated that she commonly used teaching methods such as group-work, teacher-centred, question-and-answer and textbook methods. The teaching methods that she learnt more about in the Fundisa for Change training were fieldwork, solitaire and learner-centred methods. She also used three different learner textbooks as information sources to prepare for this lesson.

For assessment purposes, she commonly used class-work, research (project) and practical activities.

The teacher also indicated that she acquired new knowledge on the following concepts during the training: Ecosystems; taxonomy; Biodiversity and Human-environment relationship

5.2.2 Analysis of ECT 06 lesson on Biomes and Human impact on aquatic Biomes

The lesson was about Biomes and how human beings have an impact on aquatic Biomes. The first part of the lesson concentrated on the terminology around the concept of Biome, then the second part dealt with human impact on Biomes (refer to Table 5.2 below). The teacher was able to code-switch to give learners a better understanding of the difficult concepts. The fact that she had recently begun teaching meant she still had knowledge about many of the concepts dealt with in the lesson as she had learnt about these at university. However she lacked teaching experience. She was working with a very large number of learners in the class and this limited her mobility and the capacity to interact with many of them. ECT 06's school had two functional computer laboratories meaning that it would be easy for learners to supplement the information by searching through the internet. However, there was no library. As part of the doings, learners learned about the South African biomes and their characteristics. They went to the school playground to identify plants and animals found in the area. With regard to relationships (relationships), the learners seemed to have worked well with one another as the pictures suggested, but it is difficult to control such a big class. Working with nature might mean that love for nature was improved. The teacher's practice traditions changed in that new teaching methods were learnt which might have impacted positively on the learners' understanding and attitudes.

Table 5.2: Practice architectures of teaching Biomes and Human impact on aquatic Biomes

Elements of practices

Project

The aims of the lesson as stipulated in the lesson plan, were for the learners to be able to:

- *define ecology, biome, biosphere and ecosystem (Specific Aim 1);*
- *list the seven major terrestrial biomes and be familiar with their distinct characteristics and locations (Specific Aim 1);*
- *solve problems by suggesting solutions to sustain or conserve an aquatic biome (Specific Aim 3); differentiate between aquatic and terrestrial biome (Specific Aim 1) (ECT 06-TP)*

Practice architectures in the site

Practice landscape

On average the school had around 60 learners in a class, and the teacher indicated that the classrooms were not big enough to accommodate them as a result, the classes were overcrowded. As the teacher indicated "*we don't even have the space to move to write something on the board ...*" (ECT 06-I, paragraph 71). The teacher had BEd Degree and her major subjects were Maths and Life Sciences. She had only one year of teaching experience.

Sayings

The concepts that were discussed during the lesson included: ecology, biomes, biosphere, ecosystem, terrestrial and aquatic biomes, eutrophication, oil spills, producers, consumers, biotic and abiotic components of an ecosystem, adaptations, Fynbos, Succulent Karoo, Nama Karoo, Savanna Grasslands, primary consumers, secondary consumers and tertiary consumers. This is list of scientific terms and concepts that learners learnt about during the lesson. Opportunities were offered for the learners to give their own examples of how humans negatively impacted on environment leading to Biodiversity loss.

Doings

The teacher began the lesson by asking the learners about some of the scientific concepts listed above to test their prior knowledge. Then the teacher explained all the listed terms and concepts for the learners to understand. The seven terrestrial biomes found in South Africa and their characteristics in terms of the vegetation and the climate, were explained. Different organisms (plants and animals) found in these areas were studied in terms of how they are adapted to living in those areas.

Then the teacher explained the aquatic ecosystem and different organisms supported by it. The human impact on aquatic biomes was discussed and the learners were given an article to read and discuss which was about human impact on aquatic ecosystems. The problems raised included eutrophication, oil spills, dumping of rubbish in water and the effect of sewerage on water.

In the practical activity given, the learners were divided into groups of nine members. They then had to go to the school yard to identify plants and animals found there, that is, in the Biome in which the school is found. They had to draw an energy flow diagram in the form of a food

Cultural-discursive arrangements

The school uses English as a medium of instruction. The teacher and most of the learners at school are Xhosa speakers. The teacher indicated that she sometimes explained the concepts in Xhosa so that the learners could understand more. She also explained that since she was recently from the university, most of the knowledge she had was gained during her studies. The teacher was the one in charge of the lesson and the learners relied on her for explaining the concepts.

Material-economic arrangements

The class in which the lesson was presented was Grade 10 and there were 67 learners in that class. The teacher indicated that the classes were full. She said: *“We don’t even move around so that we can see what they [learners] are writing because it’s too full. The classes are too full ...”* (ECT 05-I, paragraph 71).

The school has two computer laboratories and a science laboratory. It does not have a library. There are chalk-boards. Some learners did not have textbooks, so they were sharing textbooks. The teacher indicated that they were sitting in groups, but even if she wanted them not to sit in groups, they would not be able to, because there was no space.

She also indicated that even though every learner had a chair, not all of them had desks. They had to share a small desk, and this is very difficult for the learners especially when they write their assessment tasks. The teacher also had to watch them very closely during assessment as they could easily copy each other’s work.

The teaching methods that were used in this lesson included information transfer, discussion, question-and-answer and listening-with-intent.

The assessment activity that was given to the learners was classwork on South African Biomes. Group assessment in a form of poster-making was

web or a food chain about the organisms identified. The learners also had to indicate the uses of the plants and animals found in their area and the threats these organisms were facing. A rubric was used to assess the learners' work.

Several photos taken during the lessons were provided. In one photo, the teacher is seen outside the classroom with the learners in a group explaining. As they were talking they saw a bee on one of the plants and they started talking about pollination and the role played by the bees. The learners are seen taking notes as the teacher is talking. The teacher indicated that they were looking at the leaf structure, trying to explain how the leaves in that area were adapted.

In another picture, there are smiles on the learners' faces as they are looking at one particular plant. Another picture shows learners with a lady who the teacher said was from the Eco-Schools committee, who was invited to talk to the learners about the common uses of the plants that were found in that area.

In one photo learners are holding a nest that fell from the tree, while one learner is holding an insect. From these, they were learning how different organisms depend on each other, for example, for food and for shelter. One other photo shows learners collecting soil samples which they were going to study their properties such as texture, drainage and humus content.

Relatings

The teacher indicated that the learners participated well in the lesson. They were asking questions freely and also responding well to the questions asked. She also indicated that she used different teaching methods in the lesson to accommodate different learning styles of the learners. Learners' faces portrayed happy mood as they were interacting with each other and with the teacher.

also carried out. The teacher also used a test and a practical activity.

The resources that were used for this lesson included data projector, personal computer, textbook, chalkboard and some posters.

The lesson was conducted in two hours. The classroom in which the lesson was held was well ventilated.

Social-political arrangements

These are the same as in other lessons.

It was evident from the pictures that learners were enjoying the beauty of nature and appreciating the role played by Biodiversity. They were cautious not to hurt the organisms they were handling.

The invitation of someone from outside the school indicates a good relationship between the school and the community.

Dispositions (habitus)

Understandings: Learners gained more scientific knowledge as the terms and concepts were explained. The learners gained more knowledge on the characteristics of the different biomes in South Africa and on the differences between terrestrial and aquatic biomes.

Skills: The learners' scientific language skills improved. As the learners were in groups, social skills such as leadership and communication were strengthened.

Values: The learners' attitude towards the environment might have improved; respect for each other; tolerance and love for nature are a few of the values which might have been positively impacted by the lesson.

Practice traditions

The teacher indicated that she commonly used teaching methods that were teacher-centred and involved question-and-answer. She learnt more about fieldwork and round-robin methods in the Fundisa for Change training.

In terms of assessment, she usually used practicals, tests, assignments and worksheets. She got new ideas on how to use practicals for assessment. Even though she had recently left university, she did not have new information about Ecosystems, Taxonomy and Biodiversity.

The teacher used three different sources of information in preparing for this lesson. These were a learner textbook, newspaper article and an internet.

Commenting on the lesson, she said the lesson went well and most of the learners managed to get more than 40% in the test and the practical tasks given. She however indicated that when they were in the field identifying organisms, she could not answer some of the learners' questions as she did not have a field guide.

5.2.3 Analysis of ECT 07 lesson on Ecosystems – Biotic and Abiotic factors

This lesson was on Ecosystems, focusing on biotic and abiotic factors. Energy flow in the ecosystem in terms of food webs and food chains was also looked at. The lesson discussed the impact of humans on the environment. ECT 07 had 62 learners in the class (refer to Table 5.3 below) which was quite a big number. ECT 07's school as a Maths and Science focused school is supposed to receive more resources from the DBE to support teachers in teaching these subjects. This is why the school had mini-laptops. In terms of the sayings, the teacher and the learners were discussing terms relevant to the topic of the lesson and this was made possible as the teacher could explain

difficult concepts in learners' home language to help them understand. In terms of material economic arrangements the school had a computer laboratory which meant that it was possible for the learners to search for more information. Different teaching methods were used during the lesson to cater for different learning styles of the learners. With regard to the doings, the learners went out into the school grounds where they tried to establish food relationships among the organisms found. Happy learners' faces on the photos is an indication that there were good relations among learners and the learners were enjoying the lesson. The new ideas on teaching and assessment methods and the new Biodiversity content knowledge gained by the teacher impacted positively on learners' values, skills and understanding (refer to Table 5.3 below).

Table 5.3: Practice architectures of teaching Ecosystems

Elements of practices	Practice architectures in the site
<p><i>Project</i></p> <p>The purpose of the lesson was to introduce learners to the Ecosystem and its associated concepts such as biotic and abiotic factors and how these relate to each other.</p>	<p><i>Practice landscape</i></p> <p>The average number of learners in a class at this school is 60. The school is one of the selected Maths and Science focus schools which are called Dinaledi Schools. The participant has a BSc degree with majors in Botany and Zoology. She also has a Higher Diploma in Education (HDE), specialising in Physical Sciences. She has been teaching Life Sciences for 15 years.</p>
<p><i>Sayings</i></p> <p>The major concepts that were discussed in the lesson were: Ecosystem, Biotic and Abiotic factors, energy flow, food chains and food webs.</p>	<p><i>Cultural-discursive arrangements</i></p> <p>The participant together with the majority of the learners speak IsiXhosa. She indicated that it is easy to teach learners who speak the same language as yours because it would be easy to explain difficult concepts in their language in cases where they do not understand. She calls the mixture of the two languages, English and isiXhosa, "Xhongish" (ECT 07-I, paragraph 276).</p>
<p><i>Doings</i></p> <p>The teacher started the lesson by introducing and defining the following concepts: Ecosystem, Biotic and Abiotic factors. She then used a chart showing an ecosystem ask learners to identify biotic and abiotic to components, and to classify them also. Then there was a discussion on how abiotic factors affected biotic ones. The learners were then taken out to the school garden to identify ecosystems in which they were to discuss energy flow</p>	<p><i>Material-economic arrangements</i></p> <p>The school has a micro-computer laboratory which has small computers (hand-tops) that the teacher can take to class to give to the learners. But the teacher indicated that it was not yet fully operational. In addition there is a computer laboratory.</p> <p>The class in which the lesson was presented was Grade 10C which had 62 learners, but only 20 were involved in the photos. In the class they were sitting in rows. She indicated that the school</p>

through the ecosystems. The teacher then asked the learners to discuss human activities that impacted negatively on the environment.

The learners were responding to what the teacher was asking them to do.

There were photos of the learners engaged in some activities. In one photo, the learners are sitting in rows in the classroom writing some notes as the teacher is in front of the class writing some concepts on the chalk-board and explaining them. There seems to be communication between the learners and the teacher as one learner seems to be talking to the teacher, perhaps asking or answering the question, or even making an input. Three other pictures show learners outside in the school garden where the teacher said they were identifying biotic and abiotic factors, and they were also trying to establish the energy flow in the organisms found through food chains and food webs. The learners were also looking at ways in which the ecosystem was negatively impacted by humans.

Relatings

Smiles on the learners' faces indicate that they were enjoying the lesson and there was a good relationship between them and the teacher, and among themselves. The teacher indicated that the learners were excited about and interested in the lesson.

did not have a big problem with furniture; sometimes learners were sitting in threes on a seat for two learners. She also indicated that even though there many learners in the classes, the rooms were well ventilated. The lesson was a four-hour lesson.

The resources that the teacher used in this lesson include the textbook, chalk-board, chart and a flower garden in the school.

The teaching methods that were used include experimental, telling, group-work, deliberative, question-and-answer and fieldwork. The participant indicated that even though the learners liked the experimental method, it was time-consuming.

The participant further indicated that she could improve the lesson by not looking at one ecosystem but different ecosystems to compare the organisms found in them. She said looking at the good performance of the learners from the tasks given, it seemed they had understood the concepts taught. She also indicated that she covered all the requirements stipulated by CAPS in this section of the syllabus. She stressed that it was important for a teacher to follow CAPS requirements rather than relying entirely on the textbook and teaching all that was in it.

The assessment tasks used were a test and a practical. When these activities were set, the requirements in terms of meeting the cognitive levels and the skills, were taken into consideration. She indicated that the practical task given was able to address many skills such observation, recording, interpretation, following instructions, application, classification, analysis and evaluation.

Social-political arrangements

As mentioned in the other lessons.

Dispositions (habitus)

Understandings: The learners learnt about an ecosystem and its associated concepts such as biotic and abiotic factors, energy flow in the ecosystem and negative impact of humans on the ecosystem. The learners developed more knowledge on these scientific concepts.

Skills: Some of the skills covered included: scientific language, observation, interpretation, following instructions, recording, analysis, evaluation, communication and leadership.

Values: The values acquired include appreciating nature, respect, tolerance, treating each other equally.

Practice traditions

The participant indicated that the teaching methods she usually used were group-work and teacher-centred methods. Fundisa for Change improved her knowledge on the use of fieldwork.

The assessment strategies the teacher used were class-work, practical, test and case studies. The teacher indicated that she got more new ideas from the training on the use of practicals.

She further indicated that she had gained new knowledge from the training on the following concepts: Ecosystems, Taxonomy, Biodiversity and Human-environment relationship. She was very thankful to have attended the training as she had not attended any Life Sciences training before. She said: “*You know, ever since I left the university, I never had any ... any other programme that developed me more on Life Sciences*” (ECT 07-I, paragraph 295).

Three different sources were used in preparing for the lesson. These were a learner textbook, a poster and the internet.

5.2.4 Analysis of MPT 01 lesson on Population Ecology – Investigating population size

The lesson studied here was on Population Ecology, in which the learners calculated population size using the mark-recapture method. This was an improvised lesson because instead of the learners using live organisms, they used beads. In terms of the sayings, the participant was qualified to teach English Language and Life Sciences. This meant that she was better at explaining concepts and making learners understand than other teachers due to the fact that she was a language teacher. The participant could also code-switch. The teacher was also newly qualified, meaning that she did not struggle much with the content because she had recently studied some of the concepts at university. With regard to material-economic arrangements, the school was well resourced, having science laboratories, smart-boards and a computer laboratory (refer to Table 5.4 below). This means that the teacher and the learners could get information easily. In relation to the doings the participating teacher gave the learners a practical activity which was about estimating the population size of the organisms. In terms of relatings, the learners seemed to be enjoying the lesson as they were smiling and laughing during the lesson in the photos.

Table 5.4: Practice architectures of teaching Population Ecology

Elements of practices

Project

The learners were estimating the population size of organisms using the mark-recapture method.

This was a simulation exercise as they were not using the real organisms but beads.

Sayings

Some of the scientific terms discussed in the lesson were: population, population size, mortality, natality, dispersal, population fluctuations, limiting factors, carrying capacity, competition, population growth, geometric growth, aerial photography, mark recapture, simple sampling and census.

The learners were guided and helped by the teacher in learning these scientific terms.

Practice architectures in the site

Practice landscape

This school had an average of 45 learners per class. The teacher had six months of teaching practice when the Fundisa for Change training was run. She had recently finished university and has a BEd with Life Sciences and English as major courses. She indicated when she arrived at school she taught Grade 12. So the training should have been of great help to her. There were three lessons that were presented: the first lesson introduced learners to factors influencing the population size; the second was a practical investigation where learners used beads to calculate population size; and the third one was on rhino poaching in the form of a case study and class debate. The lesson discussed here is the second one, which is the practical investigation.

Cultural-discursive arrangements

The medium of instruction at the school is English while most of the learners speak Zulu as their home language. The teacher speaks SiSwati but was fluent in isiZulu, so there was no problem for her to explain some difficult concepts in isiZulu. To indicate how fluent she was in Zulu, she said: “*I can speak Zulu like a Zulu*” (MPT 01-I, paragraph 147).

Since the teacher had recently left university, some of the concepts such as Biodiversity and Human-environment relationships were still fresh in her mind. So she did not have many problems in terms of scientific language. Learners had problems with the scientific language and they relied on the teacher for explanations. She also majored in English Language which might have helped in teaching these scientific concepts in English.

Since the lesson was conducted in Grade 11, the teacher indicated that the learners had prior knowledge on some of the concepts due to the work they did in Grade 10. However they struggled to remember some of the scientific concepts due to the use of foreign language.

Doings

Photos taken during the practical showed the learners sitting in groups of three to five talking to each other while some were writing. The teacher indicated that she was introducing the simulation practical telling them what to do. One picture shows one learner pouring the beads onto another learner's hands who was trying to catch them. A second picture shows learners marking the captured beads. The teacher made the point here that had these been live animals, the learners would have been careful not to harm them as they were marking them.

Another photo showed learners putting the captured beads back into the bottle. The teacher indicated that after capturing the organisms and marking them they had to be released back into their habitat. Another learner is seen recording the number of captured organisms. The learners were encouraged to repeat the activity so that they could get reliable data. In another photo, the learners were discussing what they had recorded using a calculator to work on the formula given for finding the population size.

Relatings

The learners seemed to have interacted with each other well as the lesson proceeded without difficulties. There had been a good relationship between the teacher and the learners. With their smiling faces, one can infer that the learners were enjoying the class. The learners experienced the world of science

Material-economic arrangements

The lesson was conducted in Grade 11 class which had 43 learners. The resources used during this practical include: textbooks, computer, projector, 500ml cool drink bottles, beads, paint or permanent markers, and worksheets. The practical was carried out in a class.

The school has a library even though it is not well stocked, a computer laboratory accessible at any time, two Physical Sciences laboratories which are well stocked, fully equipped smart-boards and two Life Sciences laboratories. The school gets donations from the mines as it is situated in a mining area. There are some few charts.

Learners were sitting in rows in the class and there were two learners per desk. The class that was used was a Life Sciences laboratory and it was well ventilated.

The teacher indicated that she chose to use group-work because of the large number of learners in the class. In this practical, the teacher said she used a "learning by doing" method as opposed to "learning by listening" so that the learners could experience mark-recapture method. She was confident that even though she would have preferred using live animals, the lesson objectives were achieved and the learners understand the activity. From the mark-sheet provided, the average percentage for this activity is 67, which shows that most learners passed.

To improve the lesson, she indicated that she would first do simulation activity with the learners to give them a sense of what they would have to do when going out, and then she would take them out to work with live animals.

Social-political arrangements

The policy document (CAPS) was the one from which guidelines were obtained in terms of what to teach. School regulations, learners' and teachers' code of conduct, and the rules governing the conduction of practicals (refer to 5.2.9 for more clarification).

through the use of scientific language and doing the practical following the scientific process. From the practical activity, the learners could relate to the life of other organisms. It also taught them not to harm other organisms. The teacher indicated that they could not have used live animals *“for fear of hurting them since the learners are not trained in animal handling”* (MPT 01-TP).

From time to time the teacher referred to the skills mentioned in the CAPS curriculum that the learners were acquiring.

She said as she moved around checking the learners' individual work, she realised that some learners had some difficulties with analysing the results, but they did manage to do the calculations.

Dispositions (habitus)

Understandings: The learners gained more scientific knowledge as the scientific concepts were being explained. They also understood how other organisms live and what factors affect their lives. The teacher indicated that learners understood the mark-recapture method of calculating population size.

Skills: The general and scientific skills that the learners gained in the task include communication, leadership, recording, analysing, following instructions, reporting and mathematical.

Values: The values that were strengthened among the people involved in the task include appreciating the lives of other organisms, respect for nature, respect for each other, treating each other equally and tolerance.

Practice traditions

The participant indicated that she commonly used fieldwork, practical work and teacher-centred teaching methods in her teaching. She also gained more knowledge on how to use fieldwork and investigation methods from the Fundisa for Change training.

In preparing for this lesson, she used more than three information sources. These were two different learner textbooks and the internet.

With regard to assessment usually used practical, test, case-study assessment methods. She said the knowledge on the use of case-studies for assessment purposes also improved. She also indicated having gained more knowledge on Ecosystems and Taxonomy, which are some of the scientific terms that were dealt with in the Fundisa for Change training.

The teacher commented that the Fundisa for Change training made her change the way she was relating to the environment, and she passed this on to her learners. She said: *“After the workshop, I found myself appreciating Biodiversity more, because you know the black communities that we grow up in, a plant is just a plant. It's something you can just chop it up any time. And an animal is just an animal. You can*

run into a frog and kick it for no reason. I ... I found myself appreciating it more, and I ... I passed that on to the learners.” (MPT 01-I, paragraph 289)

5.2.5 Analysis of MPT 02 lesson on Desert Biome

This lesson was about the adaptation of animals to desert conditions, which involves describing the characteristics of desert-dwelling animals which enable them to survive. It was also an improvised lesson in which learners pretended to be those animals. The teacher spoke the same language as learners, meaning she could easily code-switch to explain difficult concepts though she was not a strong believer in code-switching. The concepts related to the topic; the names and the characteristics of the desert animals were discussed during the lesson (refer to Table 5.5). However the fact that the teacher was not a regular Life Sciences teacher meant it might have been a challenge for her to teach these concepts. In terms of material-economic arrangements, the school did not have a science laboratory. There was also no computer laboratory. It was therefore difficult for Life Science teachers to prepare experiments or practicals with standard laboratory apparatus, or to look for more information from the internet. The other problem was lack of furniture for the learners. In doings, the learners mimicked the lives of desert animals in the form of a play (refer to Table 5.5 below). In relatings, learners experienced the lives of desert animals. There might have been competition for furniture and this might have created friction among learners. The teacher gained new knowledge on Biodiversity concepts and how to teach them, the factors which would lead to learners’ improved knowledge, skills and values.

Table 5.5: Practice architectures of teaching Desert Biomes

Elements of practices <i>Project</i>	Practice architectures in the site <i>Practice landscape</i>
The lesson was on “Desert Biomes”, prepared for Grade 10 class. The main aim of the lesson was to show that desert animals have physical and behavioural characteristics that make them able to live in a desert ecosystem. The learners learnt “... about desert animals and their adaptations through individual research and by participating in a classroom activity called Adaptation Jeopardy” (MPT 02-TP).	The teacher in charge of the lesson was not a regular Life Sciences teacher. She only attended to represent the school as the Life Sciences teacher could not attend. She had to arrange for a class to do the portfolio assessment task. She only had a couple of weeks’ experience of teaching Life Sciences. She had a BEd degree, however, and one of her major courses at the university was Biology. The learners seemed to be doing well in Life Sciences as 77% of the 110 learners who wrote mid-year exams passed. The general average number of learners in a class at her school was 50. The teacher made a list of organisms, the total number of which was to equal the number of

learners in the class and these organisms were grouped into mammals, birds and fish, reptiles and amphibians, and insects and spiders. Examples of these organisms are given as geckos, roadrunners, ravens, turkey vultures, gila monsters, camels, and desert iguanas.

Sayings

Biodiversity terms used during the lesson included: biomes, desert, adaptation, mammals, birds, fish, reptiles, amphibians, insects, spiders, geckos, roadrunners, ravens, breeding patterns, physical adaptation, behavioural adaptation, social habits, hunting strategies, ecosystem, turkey vultures, and many more.

The lesson began with the discussions on desert biomes during which the teacher assessed the learners' prior knowledge on the topic. The discussions were also on precautionary measures one must take when travelling in the desert area such as always having water. The most common deserts in the world such as Sahara desert in Africa, Gobi desert in Asia, and Sonoran desert in North America, were discussed together with their common characteristics such as being dry and very hot during the day.

The Biodiversity terms introduced earlier, such as physiological and behavioural adaptations were also explained.

Doings

The teacher then allocated a card with the name of the desert organism to each student to be used in a Jeopardy card game that learners played about desert animal adaptation. The learner had to use print or online resources to describe three adaptations of the animals on their cards. They had to write these adaptations at the back of their cards and hand them to the teacher at the end of the lesson.

Cultural-discursive arrangements

The medium of instruction at school is English which is the second spoken language by the learners and the teacher. The participating teacher and the learners spoke SiSwati as their mother tongue. But the fact that the teacher spoke the same language as the learners meant that she could code-switch in areas where learners struggled to understand.

But it appeared that the teacher was not very keen on code-switching: *"They're expecting you to ... to ... teach them in their mother tongue and ... you can't do that, because you ... you ... you are ... you are killing the kids"* (MPT 02-I, paragraph 135).

She however admitted that learners whose English is not their mother tongue language *"may require additional support to develop their English Language skills. One of the major difficulties experienced by learners when learning science is learning the language of science"* (MPT 02-TP).

CAPS requires teacher to teach learners language skills, especially reading and writing scientific language. It encourages teachers to give learners assessment tasks such as essays and report writing where learners can familiarise themselves with this language (LS-CAPS, p. 19).

Material-economic arrangements

All learners have textbooks. The number of learners in the class was 32. This was a small number because that was a maths and science class. Not many learners in this school did maths and science. The teacher had reference books to use including the Fundisa for Change ones to prepare for the lesson.

The materials that were to be used in the lesson were the following: 4' - 6' index cards; pencils and paper; reference materials about deserts and

At the end of the lesson, the learners were given a take-home activity in which they had to write an essay about how their animals spend their day focusing on the adaptations which help them survive. They were to share their writings with their classmates in the next class.

desert animals including library books, encyclopaedias; and internet sources.

The teacher drew her knowledge from at least three sources of information. She explained how Fundisa for Change training helped her in this by saying: “... *we were using Biology textbook, like to check if this content is explained in this textbook and how it is explained in another textbook. As a teacher you have to go with the one that you think will be more informative to the learners*” (MPT 02-I, paragraph 229).

The school did not have a functioning computer laboratory. The library was there but with no shelves, and it was “not well organised” (MPT 02-I, paragraph 60). The classrooms had chalk-boards only and no smart-boards. The school did not have functioning science laboratories. There was a class reserved for science laboratory but it had very little apparatus. The teachers used their own personal computers. There were no charts bought by the school for the teacher to use.

The teacher indicated that there was a shortage of furniture at school, especially chairs and desks for the learners. She indicated that those learners having no furniture “*sit on the tables and some may squeeze themselves in between others*” (MPT 02-I, paragraph 96).

Relatings

In the Jeopardy card game, the learners resembled the animals on their cards, in that way they felt what it was like to live like those animals. The learners were also working with each other sharing ideas in the game and in class.

Social-political arrangements

The CAPS document guided the teacher in planning and presenting the lesson. The code of conduct for both the teacher and the learners, and the school regulations, allowed for an environment where teaching and learning could take place. There was tolerance and respect among the learners, and between the teacher and the learners. The teacher was the one leading the lesson.

Dispositions (habitus)

Understandings: The learners could understand how animals are adapted to living in the desert. They could also understand the terms that were used in the lesson;

Skills: The learners acquired more scientific knowledge. Their communication skills improved as they

Practice traditions

The teacher indicated that she normally used learner-centred and teacher-centred teaching approaches, but also depended heavily on the textbook.

In the Fundisa for Change training, she learnt about fieldwork and her knowledge on learner-centred methods also improved.

were communicating with one another and also with the teacher. They also learned about survival skills in the desert. The teacher was able to use different resources to prepare the lesson, rather than simply relying on one, which is normally the textbook.

Values: The learners could appreciate the life of desert organisms.

The teacher also indicated that she used a rubric as a common tool for assessing learners.

The participant also used three different sources to build up more knowledge on the content, rather than just relying on one. These were two different learner textbooks and a newspaper article.

She also indicated having gained new knowledge on the following concepts that were dealt with during the Fundisa for Change training: Ecosystems, Taxonomy, Biodiversity and Human-environment relationships. This knowledge helped her in planning and teaching the lesson.

(Formal assessment tools were not submitted.)
(Reflections on the lessons taught were not done.)

5.2.6 Analysis of MPT 03 lesson on Water- holding Capacity of the Soil

This lesson was an experiment to investigate the water-holding capacity of three types of soil: clay, sand and loam soil. The learners collected the soil from different spots in the school grounds and tested it. They studied the soil as an abiotic factor in the ecosystem. Water-holding capacity terms such as filtration and names of soil were discussed. The terms were made easy to understand by code-switching. In terms of material-economic arrangements, there were too many learners in the classroom, which affected the seating arrangement (refer to Table 5.6 below). The learners used the laboratory apparatus to carry out this experiment. There was no computer laboratory at this school, so it might have been difficult for a teacher or learners to find more information from the internet. The participant indicated that she used various teaching methods to enhance learners' understanding (refer to Table 5.6). There was not enough furniture for the learners in the class so learners could not sit comfortably as they were sharing furniture. These conditions affected practices such as teaching, learning, preparing worksheets for the learners or even writing on the chalk-board. Too many learners in the class resulted in disciplinary problems (refer to Table 5.6 below). The participant changed her old ways of teaching as she acquired new content knowledge and new ideas on teaching and assessment. This might have enhanced learners' understanding and acquisition of skills and values.

Table 5.6: Practice architectures of teaching Water-holding Capacity of the Soil

Elements of practices

Project

The aim of this lesson was to demonstrate the water-holding capacity of the soil, and it was presented in Grade 10. The other aim was for learners to gain scientific skills and knowledge.

Sayings

Some of the terms used in the lesson include: soil type, filtration, filter funnels, measuring cylinders, filtrate, clay soil, loam soil, sand soil and abiotic factors. The learners used scientific language as they were engaged in the practical activity.

The participant also gave learners a class test at the end of the topic (Ecosystem). The average performance of the learners was 37% of which she admitted was not good. She thought learners did not perform well because: she might not have covered all the work required to have been covered; an essay question on human impact on Biodiversity was difficult for the learners and learners not being able to link what they had learnt in real life situation. She indicated that perhaps she should use a number of different assessment tasks prior to giving a test or an exam, and she should give learners tasks that were more interesting and challenging while at the same time providing more information and encouraging more participation.

Practice architectures in the site

Practice landscape

MPT 03 had been teaching Life Sciences for seven years and she has an ACE in which she majored in Biology. The general average number of learners per class in her school was 60. This lesson is the last of the three lessons conducted. The first one introduced learners to abiotic factors in an ecosystem, and the second one was a case study on human impact on the environment. The lesson was in a form of a practical, which the teacher also used as an assessment task. A worksheet was provided to the learners to answer the questions as they were doing a practical and an assessment rubric was also used.

Cultural-discursive arrangements

The medium of instruction at school is English which is the second spoken language of the learners and the teacher. The participating teacher's home language is Sepedi, and the majority of learners at the school spoke isiZulu as their mother tongue. The teacher indicated that she could also speak Zulu. So she sometimes explained the difficult scientific terms in Zulu so that the learners could understand better, especially when it came to naming plants in scientific terms. She indicated that her learners did not struggle much with English, but she had to help in isiZulu at times (MPT 03-I).

The learners also used the scientific language with the help of the teacher as they were involved in discussions.

Doings

The learners were divided into four groups, and were given beakers to collect soil from different locations in the school compound. Then they had to carry out the experiment in the class. The following was the “method” of doing the experiment:

1. *Use pencil and label the filter paper for each soil sample A, B and C, and place it in each measuring cylinder;*
2. *Place 3 teaspoons of each soil sample into each, correctly marked with pencil;*
3. *Pour 50ml of water in each sample;*
4. *Using a stopwatch, record how long it takes for filtrate water to drain in each filtrate till the last drop (MPT 03-TP).*

As the learners were carrying out the practical, they were answering the questions on the worksheet provided and also using the rubric to guide them. Learners also wrote a test. This test covered the three Specific Aims in Life Sciences.

Photos of the lesson were also provided. In the photos, the teacher is seen writing on the chalk-board explaining the concepts and perhaps even the experiment procedure, with measuring cylinders, filter funnels, beakers and filter papers on the table next to her. Another picture shows learners sitting in a group talking to each other as they were looking at the worksheet. One picture shows learners collecting soil samples using beakers. In another picture three labelled soil samples in three beakers are seen next to three measuring cylinders with filter funnels. One picture shows a learner pouring water into one beaker containing the soil, then pouring the mixture into the measuring cylinder through the filter funnel. In another picture, two learners can be seen using the stopwatch to record the water-flow rate. Then the learners are seen

Material-economic arrangements

The lesson was taught in two classes, one with 48 learners and the one with 57. The teacher indicated that generally the learners were overcrowded in the classes and sometimes it was not possible to even move around in the class. The class of 48 learners sat in groups, but the larger class could not sit in groups because there was too little space, so they were sitting in rows.

The following apparatus were used during the experiment:

- (i) *15ml of three soil types (sample A, B, and C);*
- (ii) *Three 10ml measuring cylinders and 50ml beaker;*
- (iii) *Three thistle funnels;*
- (iv) *Filter papers or cotton wool;*
- (v) *Stopwatch and marking pencil. (MPT 03-TP)*

Other materials included the chalk-board, water, books and Fundisa for Change materials.

The school had no functioning computer laboratory; teachers used their own personal computers (MPT 03-I). The participant indicated that she did write down some of the learners’ work on the chalk-board as this took too much of her time. There were some tablets and a smart-board but these were used by Maths teachers and certain learners only.

The participant also indicated that the school library was not functioning properly. It was only used to keep books. There were few reference books available. She said that she did have a teacher’s guide and some reference books for planning lessons.

When asked whether there was enough furniture for the learners or not, she said: *“Oh! It’s a very big problem that one. They share. You find that two are seated on a table that is supposed to be used by one, and they also share ... the chairs”* (MPT 03-I, paragraph 157). She further indicated that because of this problem, instead of giving them notes on writing on the chalk-board, she photocopied the notes for the learners.

The classrooms were however well ventilated.

answering the questions on the worksheet. One could see from the pictures that the learners were talking to each other and some were smiling which indicated they were enjoying the lesson.

The teacher had indicated that she would be moving around to assist learners in terms of giving guidance, explaining, facilitating and marking the learners' work. The other method she used in the lesson was the participatory method in which learners were working in groups and actively involved. She also realised that the practical covered Specific Aims 1 and 2, but not 3, which was the area that she had to improve on.

Time seemed to have been against her as she indicated that for next time she needs to organise her class well to manage the time effectively. She noted that learners did not complete the practical within the allocated time.

Relatings

The participant seemed to have had some difficulties in managing the class because of the size of the class. She talked about high noise levels and showing of respect to all, and also treating each other equally.

Dispositions (habitus)

Understandings: Learners gained more knowledge on the scientific terms used in the lesson.

Skills: A range of general and scientific skills were covered in the experiment. These included: communication, time-management, leadership, listening, recording, reporting, following instructions, handling apparatus, measuring, mathematical skills, hypothesising and following the scientific method of investigating phenomena.

Social-political arrangements

There must have been conflict among learners in terms of furniture (chairs and desks).

In the same way the learners' code of conduct and the teacher's code of conduct, together with school rules and regulations, played a part for the lesson to have progressed. There are also rules that learners must follow when doing a practical activity. The CAPS policy provided guidance in selecting and teaching the topic.

Practice traditions

The participant indicated that she usually used group-work, learner-centred and teacher-centred methods in her teaching, but she also learnt about a case study method in the Fundisa for Change training. This is what the teacher said about how Fundisa for Change helped her: *"It was only after the workshop, that I started understanding that I have to use this method. Then maybe like in one lesson, one topic, I can teach with this method then the following day I can apply this one, so that there should be ... learners should be interested in the lesson because most of the time, we do presentation, presentation and at some*

Values: The learners were working together and interacting with the teacher, thus the following values were evident: respect, tolerance, honesty and trust.

stage maybe like you would be teaching things like case studies” (MPT 03-I, paragraph 334).

The teacher also used CAPS in teaching this topic. In terms of teaching and assessment methods, she indicated that she had used Fundisa for Change material which she found to be “very useful” (MPT 03-I, paragraph 195).

The participant also used three different sources to build up more knowledge on the content, rather than just relying on one. These were two learner textbooks and an information leaflet. This is what Fundisa for Change recommends teachers to do in their trainings: teachers should always try to do a little bit more than what is expected of them.

The commonly used assessment methods by the teacher included class-work, research project, practical, test, assignment and homework. She indicated that she gained new assessment ideas on using practicals and case-studies from the training. New knowledge on Ecosystems, Taxonomy, Biodiversity and Human-environment relationships was also gained which helped in the presentation of the lesson.

5.2.7 Analysis of MPT 04 lesson on Water Retention Properties of the Soil as an Abiotic Factor (Ecosystem)

This lesson is the same as that conducted by MPT 03 (section 5.2.6). The difference is that instead of the learners using the normal laboratory apparatus such as beakers, they improvised by using 2-litre plastic bottles and this was done at different places by different teachers. In terms of the sayings, some concepts are named differently even though they mean the same thing, for example water-holding capacity and water retention. Code-switching by the teacher helped to promote learners’ understanding. In doings, the teacher used a number of teaching and assessment methods to meet the needs of different learners. The shortage of furniture, library and a computer laboratory might have affected the teaching and learning process negatively (refer to Table 5.7). The library and the computer laboratory are a source of information, thus if they are not available it is difficult to supplement the knowledge obtained from the textbook. With regard to relatings, the big number of learners in a class might have resulted in disciplinary problems, with learners also fighting over furniture and space. Attending the training led to the teacher changing his teaching methods as new methods were learnt; hence different skills, values and understanding might have been acquired due to this.

Table 5.7: Practice architectures of teaching Water Retention of Soil

Elements of practices

Project

The main aim of the Grade 10 Biodiversity lesson was to investigate the water-holding capacity of different types of soil. Furthermore, learners had to investigate which soil was good for crops.

Sayings

The main concepts that were explained in the lesson included ecosystem, community, population, habitat, biotic and abiotic factors, water retention, clay soil, loam soil and sand soil. These help develop the scientific language in learners.

The teacher further indicated that he needed to improve his lessons by linking them with learners' daily lives.

The teacher, in his comments, indicated that the lesson went well as the objectives of the lesson were met. He also said that the teaching methods chosen were also used well.

Doings

The methods the teacher used included fieldwork, experiment, learning by doing, investigative, group-work and power-point presentation.

Practice architectures in the site

Practice landscape

The average number of learners per class at this school is 50. The participant has a teaching experience of one year and has a BEd Degree in Agriculture. He indicated that Biology was one of his major courses. But he was not teaching Life Science. He attended the training because the Life Sciences teacher was attending CAPS training organised by the District Education Department. Three lessons had been presented. The first lesson was an introduction to ecosystems and biotic and abiotic factors; the second lesson was a fieldwork where learners had to go out of the class to identify biotic and abiotic factors in the school yard; and the third one was a practical in which learners investigated the amount of water that could be held by each of the three types of soil (clay, loam and sand soil). This is the lesson that is being discussed here.

Cultural-discursive arrangements

The language of instruction at school is English, and most learners at the school and the teacher speak SiSwati as a Home Language. The teacher also believed in code-switching to help learners understand the concepts. This is what he said: "*It makes ... it makes it easier because if maybe you explain something in English maybe they don't understand, you code-switch to their home language so that they can understand better ...*" (MPT 04-I, paragraph 149).

The learners were learning scientific language as the teacher was presenting the lesson. The teacher indicated the Fundisa for Change training had helped him gain more knowledge on the Biodiversity concepts, which also contributed to the success of the lesson.

Material-economic arrangements

The participant indicated that most of the classes had 50 or more learners except for those who were doing Physical Sciences in which the number of learners was less than 50 (MPT 04-I, paragraph 26). He said: "*Yes, our classes are too congested, sometimes you find that they*

The learners worked in groups for the practical. The teacher gave instructions, explained the concepts and moved around to help learners.

For assessment, the teacher gave learners a test, a practical and a project.

Several pictures were taken to show how the lesson progressed. There is one photo in which learners are sitting in groups and there is a communication between the teacher and the learners. The teacher indicated that he was moving around explaining to the learners what they were to do so that they would not be left behind. There were 14 learners in the group and some were standing. In another picture the teacher is standing in front of the class with a 2-litre bottle to demonstrate to the learners what they had done so that they could realise their mistakes. Another picture shows the teacher and the learners outside the class in the school yard. The teacher said he was explaining to the learners what they were to do and how they were to do it.

Relatings

The learners in the class seemed to be enjoying their class as there smiles on some of the learners' faces. The teacher also created an environment where learners could easily ask questions as he was moving from group to group trying to help them. By so doing, he was also trying pay attention to each learner.

[learners] are above 50" (MPT 04-I, paragraph 24). But in this particular class there were about 45 learners because this was a science class.

The teacher used a chalk-board, textbooks, internet, projector, school yard, projector screen and Fundisa for Change material to prepare for the lesson. The school has a science laboratory, even though the practical was conducted in the class. The participant did indicate that the school had some other Life Sciences resources that teachers could use which included models and skeletons. Some classes had no electricity because the plug-sockets had been vandalised.

For the practical, which was conducted in one hour, the following apparatus were used: clay soil, sand soil, loam soil, recording sheet, water, and 2-litre bottles. The 2-litre bottles were cut into two pieces. The top part of the bottle was used as a funnel, while the bottom one was used as a collecting beaker. The soil was collected from the school yard which the teacher indicated that it was small since the school is surrounded by the community.

The teacher indicated that for that particular class in which this lesson was conducted, there was no shortage of furniture, but there was a shortage in other classes where there were cases of two learners sitting on one chair, or cases of learners sitting on top of the desks because of having no chairs. The school did not have a library nor a computer laboratory.

Social-political arrangements

The teacher was in control of the class. There was no clear indication of whether there were group leaders chosen, but the learners seemed to have conducted themselves well in their groups as they were able to carry out the activity. This could also be attributed to the fact that learners' code of conduct and school regulations were being observed. As a rule of thumb, each school has a code of conduct for learners while that of the teachers has been developed by SACE. The teacher also knew his roles and responsibilities as he was guided by CAPS in planning and presenting the lesson.

There are also rules that learners have to follow when carrying out a practical activity.

Dispositions (habitus)

Understandings: The learners' knowledge on Biodiversity concepts improved as they were engaged in a lesson.

Skills: Learners were involved in a wide range of scientific process skills which included measuring, recording, predicting, hypothesising, interpreting, drawing conclusions and data presentation as they were conducting the practical.

Values: As the learners were working together in groups, they were able to show respect to each other by allowing group members to play their different roles. There was also a mutual respect between the learners and the teacher which was the reason why the lesson was presented.

Practice traditions

The participant also used three different sources to build up more knowledge on the content, rather than just relying on one. These sources were two different learner textbooks and the internet.

The commonly used teaching methods by the teacher included group-work and teacher-centred methods, and with the help of the Fundisa for Change training, he learnt more about the learner-centred method. Had it not been for the Fundisa training: *“What I was going to do it was getting into the class, having the mentality that the learners do know sand soil, you know, maybe I was going to draw some drawings on the board, indicating that this is sand, this is what, not letting the learners see exactly what we are talking about”* (MPT 04-I, paragraph 241).

The assessment methods the teacher commonly used in class included class-work, practicals, tests and assignments.

The participant further indicated that his knowledge had improved in the following concepts that he learnt about in the training: Biomes, Ecosystems, Taxonomy, Biodiversity, Human-environment relationship. This knowledge helped the teacher in the planning and presentation of the lesson.

5.2.8 Analysis of MPT 05 lesson on Biosphere to Ecosystems

This lesson was mainly about the conditions enabling the Earth to sustain life. The Biosphere was the main focus of the lesson, but other related concepts such as the hydrosphere, atmosphere and lithosphere were also considered. Different terms which are specific to the topic were covered (refer to Table 5.8 below). The participant could code-switch and he spoke the same language as his learners. In relation to material-economic arrangement, the learners had furniture in this school and they were smaller in number in the class. However, the type of desks the learners were using prevented them from being arranged differently and this might have hindered the teacher from arranging the class the way he wanted to. The pictures showed a happy mood among learners, which could be a sign that they were enjoying the lesson. The teacher reported having gained new teaching and assessment ideas, and new content knowledge. These might have improved learners' knowledge, skills and values.

Table 5.8: Practice architectures of teaching Biosphere to Ecosystems

Elements of practices	Practice architectures in the site
<p>Project</p> <p>The lesson had three objectives that the learners were to achieve:</p> <ul style="list-style-type: none">• <i>Understand the unique conditions that enable the earth to sustain life;</i>• <i>Realise the various levels at which the earth supports life;</i>• <i>Appreciate the range across which life is possible;</i>• <i>Be able to define the terms biosphere, hydrosphere, atmosphere and lithosphere; and</i>• <i>Know the various components of the biosphere and its characteristics.</i> <p>(MPT 05-TP)</p>	<p>Practice landscape</p> <p>The average number of learners at the school was 45. Generally the classrooms are smaller, that is why there was still overcrowding even with this number of learners in a class. The teacher had been teaching Life Sciences for four years. The participant took Biology as one his major subjects at the university. The lesson was covered in two hours.</p>
<p>Sayings</p> <p>The major concepts that were covered in the lesson included: Biosphere, Atmosphere, Hydrosphere and Lithosphere. Some other concepts that were discussed were Biodiversity, Taxonomy, Endemism, Classification and Indigenous.</p>	<p>Cultural-discursive arrangements</p> <p>The medium of instruction was English. The learners and the teacher spoke SiSwati as their home language. As indicated before, this could have prevented the learners from understanding the concepts easily. The teacher also indicated that in cases where learners seemed to have difficulty in understanding the concepts, he explained in SiSwati, as he said “<i>to enhance their understanding</i>” (MPT 05-I, paragraph 171).</p> <p>The learners’ scientific language skills were also improved as they were discussing scientific concepts.</p>
<p>Doings</p> <p>The teacher started by reminding learners about the previous work, then introduced them to the factors that are important in life which are the atmosphere, the hydrosphere and the lithosphere. In the pictures provided, the teacher and a group of seven learners is seen on the backyard of the school looking for organisms on the ground. The teacher said they were looking at both the plant and animal species to classify them according to their similarities and differences. They were</p>	<p>Material-economic arrangements</p> <p>The resources that the teacher used included textbooks, teacher’s guide, projector, computer, internet, chalkboard, school yard and Fundisa for Change materials.</p> <p>In preparing for this lesson the teacher used three different sources of information to strengthen his knowledge on the concepts. These sources were two different learner textbooks and an internet source.</p> <p>Two Grade 10 classes were involved, one with 28 learners and the other one with 36. The learners</p>

using the Carl Linnaeus way of classifying organisms.

In the other picture the learners are having a discussion with the teacher as some are recording their observations. The teacher said he was explaining to them what they should look for when classifying organisms. In the last two pictures the teacher is in the class with the learners. In one picture he is writing the concepts on the chalk-board, and as he indicated, he was giving learners some notes about the classification system. In the second picture, he said he was rounding off the lesson by further explaining some concepts and asking learners questions to test their level of understanding.

Relatings

The learners seemed to be enjoying the lesson as portrayed by the happy mood their smiling faces. This indicates that there was a good relationship among the learners themselves, and between the learners and the teacher. The learners exercised caution when handling organisms so as not harm them.

Dispositions (habitus)

Understandings: Learners gained scientific knowledge in relation to the terms that were discussed in the lesson.

Skills: In addition to the scientific skills that were mentioned before, the teacher indicated that the learners developed analytical as well as problem solving skills.

Values: Mutual respect, tolerance, responsibility, love for nature and treating each other equally are some of the values that were observed.

were sitting in rows due to the nature of the school furniture that they were using (double-chair desks). The classes were well ventilated and all learners had furniture. The school has a mobile micro science laboratory with all the necessary material which the teacher could take to class to use.

The other teaching method that he used in this lesson was the question-and-answer method. He also gave learners a worksheet.

Social-political arrangements

These are the same as explained in the other lessons.

Practice traditions

The participant indicated that he usually used fieldwork, teacher-centred and question-and-answer methods in teaching Life Sciences. In the Fundisa for Change training, these methods together with learner-centred approach, were further strengthened. He also commented on taking learners out, which he did in this lesson: *"I've noticed that taking learners out and view the ... the thing that you are talking about ... that one has more influence"*(MPT 05-I, (paragraph 365). The participant indicated that he usually used practicals and tests for assessment, and he learnt more about worksheets in the Fundisa for Change training. He even used a worksheet during this lesson.

With regard to assessment, the participant indicated there were few higher order questions in the test given to the learners, also there were few questions on Biomes, a topic which is very broad. He further said that he had gained more knowledge during the training in the following concepts: Biomes and Ecosystems.

5.2.9 Summary: Teaching Biodiversity practice architectures (enabling or constraining factors)

This section is a summary of all the Biodiversity lessons seen through the theory of practice architectures' lens. The characteristic sayings, doings and relatings in these Biodiversity lessons are summarised below, with the teaching of Biodiversity practice architectures. The main purpose of the lessons presented was to impart Biodiversity knowledge to the learners. Biodiversity, in this case, is part of Life Sciences, meaning that it was not only the knowledge that learners were meant to gain but also the intention was to improve their scientific language and process skills. The lessons were also intended to improve the learners' attitudes towards science, and specifically towards Biodiversity.

The teaching of Biodiversity must also fulfil the three main purposes of studying Life Sciences. These are:

- *The Development of Scientific Knowledge and Understanding;*
- *The Development of Science Process skills (Scientific investigations); and*
- *The Development of an Understanding of Science's Roles in Society (LS-CAPS, p. 12).*

5.2.9.1 Key features of the practice landscape

All the teachers who presented these lessons were fully qualified. Three of the eight teachers who submitted their portfolios were not regular Life Sciences teachers. They attended the training because the Life Sciences teachers in their schools could not attend. These teachers are MPT 03 who was teaching Tourism and English Language, MPT 04 who was teaching Agriculture, and ECT 05 who was teaching Geography. These teachers, however, indicated that they had studied Biology as one of their major subjects at their teacher training institutions. The subjects that they teach have Biodiversity sections in them. They were therefore not total strangers to Biodiversity. The knowledge and skills gained from the Fundisa for Change training gave them confidence to teach those topics they presented.

Teachers as facilitators of a teaching and learning process were the ones who controlled the lesson, and to whom learners looked up for guidance and for Biodiversity knowledge and skill acquisition.

5.2.9.2 Key features of the sayings

As Tables 5.1 to 5.8 above show, it is expected of the learners to acquire scientific knowledge and scientific language skills. They are also expected to acknowledge and appreciate the role played by

science in society, which means that their attitude towards science is expected to improve as they learn more about science.

Several Biodiversity topics, which included Classification (refer to Table 5.1), Biomes and Human Impact (refer to Table 5.2), Ecosystem (Biotic and abiotic factors, and their properties) (refer to Table 5.3), Population Ecology (refer to Table 5.4), Biomes (refer to Table 5.5), Water-holding Capacity of the Soil (refer to Tables 5.6 and 5.7) and Biosphere to Ecosystems (refer to Table 5.8), were covered by the participating teachers. The learners were gaining new scientific knowledge and skills as they were engaged in the lessons.

The sayings, however, were influenced by cultural-discursive arrangements that influenced the lessons.

5.2.9.3 Cultural-discursive arrangements that influenced the lessons

All the schools in which the participating teachers work use English as a medium of instruction but none of the learners in these schools speak English as their home language. The learners in the three schools in the Eastern Cape (ECS-5, ECS-6 and ECS-7) (refer to Tables 5.1 to 5.3) speak isiXhosa as their Home Language, and in three Mpumalanga schools (MPS-2, MPS-4 and MPS-5) (refer to Tables 5.5, 5.7 and 5.8) the learners are Swati speakers, while in the remaining two Mpumalanga schools (MPS-1 and MPS-3) (refer to Tables 5.4 and 5.6), the learners are Zulu speakers. This means that the science learners are faced with two language tasks: learning scientific language and also learning English language.

The participating teachers did not speak English as their mother tongue. The Eastern Cape participants (ECT 05, ECT 06 and ECT 07) (refer to Tables 5.1 to 5.3) are Xhosa speakers and for Mpumalanga participants, MPT 03 (refer to Table 5.6) speaks Pedi while the other four (MPT 01, MPT 02, MPT 04 and MPT 05) (refer to Tables 5.4, 5.5, 5.7 and 5.8) speak Swati as their home language.

The fact that both the learners and the participating teachers were not English speakers created a challenge in so far as learning Biodiversity is concerned. Another challenge is that of learning the scientific language to which the learners are not used.

However, the fact that the participating teachers were able to speak the same language as the learners meant that they could code-switch to help learners understand better. All the participants except

MPT 02 (refer to Table 5) believed in code-switching as a way of trying to help learners understand the difficult concepts. However, ECT 05 (refer to Table 5.1) warned that teachers must not spend too much time explaining the concepts in learners' home language as they are expected to write their assessment tasks in English. She further indicated that learners “*give you what you give them*” (ECT 05-I, paragraph 246), meaning that they will end up answering the questions in their own language if the teacher always explains in their own language.

CAPS indicates that Life Sciences teachers are also required to teach learners language skills: “*Teachers of Life Sciences should be aware that they are also engaged in teaching language across the curriculum. This is particularly important for learners whom the Language of Learning and Teaching (LoLT) is not their home language*” (LS-CAPS, p. 19).

There were also key features of the doings.

5.2.9.4 Key features of the doings

A range of activities were developed by the teachers for the students. ECT 05, ECT 06, ECT 07 and MPT 05 developed practical activities in which the learners worked with the organisms in their habitats, identifying, classifying and finding out how they related to each other and to the environment in which they lived. These organisms formed the biotic part of the ecosystem. MPT 01 developed a simulation activity in which the learners worked with beads instead of live organisms to do a mark-recapture activity to estimate the population of organisms (refer to Table 5.4). MPT 02 let learners play a game in which they portrayed the lives of desert animals to indicate how they were adapted to living in the desert (refer to Table 5.5). MPT 03 and MPT 04 gave their learners a practical activity in which they tested the water-holding capacity of the different types of soil (loam, clay and sand) (refer to Table 5.6 and 5.7 respectively). All the activities were hands-on and were done by the learners with help from the teachers through facilitation, guidance, answering learner questions, explanation of the scientific terms and leading the discussions. The learners had worksheets which they filled in as they were doing the activities.

As the learners were involved in the lessons they worked in groups, sharing ideas and helping each other. They interacted with the teacher, asking and answering questions. The teachers indicated that their lessons went well.

The doings were shaped and influenced by material-economic arrangements.

5.2.9.5 Material-economic arrangements

Table 5.9 summarises what the participating teachers indicated about the conditions with regard to the resources, infrastructure and average class sizes at their schools:

Table 5.9: Material-economic conditions at schools

Participant ID	Conditions					
	Learner textbooks	Furniture (Chairs & desks)	Functioning science laboratory	Functioning computer laboratory	Library	Average class size (actual number in this class)
ECT 05	x	x	x	---	x	60 (76)
ECT 06	x	x	✓	✓	x	60 (67)
ECT 07	---	✓	---	✓	---	60 (62)
MPT 01	---	✓	✓	✓	✓	45 (43)
MPT 02	✓	x	x	x	✓	50 (32)
MPT 03	✓	x	✓	x	✓	60 (48&57)
MPT 04	✓	---	✓	x	x	50 (45)
MPT 05	✓	---	✓	✓	x	45 (28&36)

(x = unavailable; ✓ = available; --- = no comment)

5.2.9.5.1 Learner textbooks

Two of the three teachers in the Eastern Cape (ECT 05 and ECT 06) indicated that not all of their learners had textbooks (refer to Table 5.1 and 5.2). The learners had to share the available textbooks. In the case of Mpumalanga, four teachers (MPT 02 to MPT 05) (refer to Tables 5.5 to 5.8) said they did not have major problems with learners' textbooks. CAPS stipulates that "Every learner must have his or her own textbook" (LS-CAPS, p. 19), meaning that the policy binds the schools to provide each learner with a textbook. Textbooks play a very big role in the process of teaching and learning. They are the tools of reference that learners use to gain more knowledge and understanding. Textbooks also have activities that teachers can refer learners to, to further strengthen the ideas discussed in the lessons. The shortage of textbooks creates a very big challenge for learners.

In trying to overcome this problem of learner textbook shortage, ECT 05 indicated that she usually photocopied the information that learners needed (refer to Table 5.1). As she indicated, this created friction between teachers and the school management (ECT 05, paragraph 106).

5.2.9.5.2 School furniture

ECT 05, ECT 06, MPT 02 and MPT 03 complained of a shortage of furniture (refer to Tables 5.1, 5.2, 5.5 and 5.6) for the learners, to such an extent that sometimes learners sat on the desks or squeezed themselves between others (MPT 02) while some stood (ECT 05) or shared a single desk or chair (ECT 06 and MPT 03) during the lessons. This is hard for the learners, and it clearly affects their learning in a negative way. It is also difficult for the teachers as this affects the way they teach and assess learners. As ECT 06 indicated: *“When they [learners] write a test, it’s difficult, because you have to ... to keep your eyes open ...”* (ECT 06-I, paragraph 134). ECT 07 and MPT 01 indicated that they did not have a major problem with regard to furniture at their schools (refer to Tables 5.3 and 5.4).

5.2.9.5.3 Science laboratories

With regard to functioning science laboratories, five of the schools (ECT 06, MPT 01, MPT 03, MPT 04 and MPT 05) had stocked and functioning science laboratories, with MPT 01’s school being an exception, having four fully stocked science laboratories (two for Life Sciences and two for Physical Sciences) (refer to Tables 5.2, 5.4, 5.6, 5.7 and 5.8). ECT 05 and MPT 02 did not have functioning laboratories at their schools (refer to Tables 5.1 and 5.5). The absence of science laboratories poses a challenge to the learners and the teachers as this would mean that there is no apparatus available. This makes it difficult to carry out experiments. The teachers were encouraged to improvise to try to minimise the impact of material shortages.

5.2.9.5.4 Computer laboratories

ECT 06, ECT 07, MPT 01 and MPT 05 had computer laboratories in their schools (refer to Tables 5.2, 5.3, 5.4 and 5.8) while MPT 02, MPT 03 and MPT 04 did not (refer to Tables 5.5 to 5.7). For the schools without laboratories, it is difficult for learners to access online information. For the teachers who do not have personal computers, it is also a challenge to prepare for the lessons by developing worksheets or even compiling notes for the learners, as MPT 03 indicated: *“It’s a problem. [Laughing] We use handwritten ones [worksheets]”* (MPT 03-I, paragraph 140).

5.2.9.5.5 School libraries

Only three teachers (MPT 01, MPT 02 and MPT 03) had libraries (refer to Tables 5.4 to 5.6) in their schools, while ECT 05, ECT 06, MPT 04 and MPT 05 indicated that they did not have them (refer

to Tables 5.1, 5.2, 5.7 and 5.8). Libraries are important both for teachers and learners for reference material. It is particularly more challenging for learners as they have to read more in order to improve their language skills.

5.2.9.5.6 Large classes

All the participating teachers complained of having too many learners in the classrooms at their schools, the range being from 45 to 60 learners per class. Only two teachers (MPT 05 and MPT 02) indicated having relatively few learners in their Life Sciences classes. The rest of the teachers had more than 40 in their classrooms, the biggest class being that of ECT 05 with 76 (refer to Table 5.1). With these big numbers in classrooms, there will be limited space available during the lesson. Sometimes it is even difficult for the teacher to move around to help other learners or write on the board (ECT 06), or even for the learners to write in their notebooks (MPT 03). MPT 03 indicated that to relieve learners of writing notes in such a packed environment, she photocopied notes for them (refer to Table 5.6).

CAPS indicates that: *“Ideally, every learner should have access to sufficient workspace and equipment to carry out investigations. For safety reasons, no more than three learners may share space and equipment in instances where space and equipment are limited due to large classes”* (LS-CAPS, p. 19). It further suggests that the Life Sciences classroom or laboratory should have the necessary equipment to facilitate the process of teaching and learning (*ibid.*). But the reality is the situation in schools is very different from what the government suggests.

5.2.9.5.7 Other conditions

- *Some attendees not being regular Life Sciences teachers:* The participating teachers who were not regular Life Sciences teachers at their schools were MPT 02, MPT 04 and ECT 05. Even if these teachers did give feedback to their Life Sciences colleagues at school, the experience they gained from the training would not be passed onto to them. The feedback normally would be in the form of a report-back meeting, and not a workshop, meaning that there would still be a lot of information and skills that would not be passed on to the concerned teacher. It is also unlikely that these teachers would present these lessons when they got back to their schools. Commenting on this issue, MPT 01 said: *“... but there were some teachers who were not Life Sciences teachers who were there. And for them it was useless, and instead of them, they could have included Life Sciences teachers who could have actually gained from this workshop”* (MPT 01-I, paragraph 348).
- *The context of the school:* MPT 01 indicated that her school received many donations from the mining companies surrounding the school, which was the reason why her school was well

resourced. On the other hand, ECT 05 indicated that since her school was situated in a community with low socioeconomic status, it was difficult to fundraise for buying resources.

- *Availability of smart-boards:* Two participants from Mpumalanga (MPT 01 and MPT 03) indicated that their schools were equipped with interactive whiteboards (usually called smart-boards) to facilitate the teaching process. These smart-boards come with educational computer software which both teachers and learners can use. Some of these educational materials include simulations in a form of animations where real life situations can be mimicked. These tools provide better clarity of the difficult concepts.

5.2.9.6 Key features of relatings

In all the classes, there seemed to be a good relationship between the teachers and the learners as the lessons were conducted. It was in ECT 05's lesson where she had a disciplinary problem with some of the learners who opted not to be part of the class, but as she said, the reason might have been that she was not teaching Life Sciences.

In the photos taken during the lesson, the learners were seen laughing, smiling, talking to each other and to the teacher. These actions revealed a good and friendly mood among learners themselves and between the learners and the teachers.

Some of the activities might have improved the learners' attitudes towards science as they learnt about Biodiversity and its importance, and towards other organisms as they were handling them in reality or in simulated activities. I also think that the activities did have a positive impact on the way teachers associated themselves with nature. This was confirmed by MPT 01 when she said:

... after the workshop, I found myself appreciating Biodiversity more, because you know the black communities that we grow up in, a plant is just a plant. It's something you can just chop it up any time. And an animal is just an animal. You can run into a frog and kick it for no reason. I ... I found myself appreciating it more, and I ... I passed that on to the learners (MPT 01-I, paragraph 289).

However, shortage of textbooks, inadequate furniture and overcrowding in the classrooms might have caused tensions among learners as they fought for these resources and to occupy space for learning, thereby negatively impacting on the teaching and learning process.

5.2.9.6.1 *Socio-political arrangements affecting relatings*

Teachers followed what was laid down in the CAPS document in terms of the Biodiversity topic taught. The teaching and learning of Life Sciences in CAPS has to fulfil the general aims of CAPS, which are in line with the Principles in the constitution of the country as indicated in section 2.6. This means that as the teachers teach they must also emphasise those values and skills that would make learners better citizens.

The process of teaching and learning is also managed and controlled by certain rules and regulations, starting from the South African Schools Act (Act 84 of 1996) describing what the school is, down to what happens in the classroom (classroom rules) (South Africa, 1996). The teachers' code of conduct as spelt out by the Employment of Educators Act (Act 76 of 1998) controls the behaviour of the teacher in school, in the classroom and in interacting with the learners (South Africa, 1998). Each school also has rules and regulations to manage the teaching and learning process at school, and it is recommended that each teacher should have his or her class rules to manage what happens in the class. Furthermore, the science laboratories should also have rules so that learners know how to conduct themselves when in the laboratory as some of the materials kept there are very dangerous.

MPT 01, being a new teacher and with no experience, talked of little support that she got from her colleagues, which made it difficult for her to cope with her work. The fact that she was made to teach Grade 12 was even more challenging. But through Fundisa for Change training, she managed to network with other Life Sciences teachers for support.

5.2.9.6.2 *Dispositions (habitus)*

Understandings: There was a lot of scientific knowledge and understanding gained both by the teachers and the learners during the lessons.

Skills: A wide range of skills was covered by the activities. These included scientific process skills, some of which are: following instructions, hypothesising, handling equipment, making observations, recording information, measuring, interpreting, analysing information, critically evaluating information, categorising information, identifying variables and drawing conclusions; social skills which include: communication, leadership, decision-making, team-work and management; and scientific language skills as they learned new terms and concepts.

Values: These include love for nature, appreciating nature, respect, responsibility, friendship, tolerance and honesty.

5.2.9.6.3 Practice traditions

It was indicated in section 2.2.4 that there are meta-practices which eventually influence the development of smaller practices such as the teaching and learning of Biodiversity. One of the meta-practices which is evident here is the role played by initial and continuing teacher education. Newly qualified Life Sciences teachers in this study (MPT 01 and ECT 06) indicated that they had background knowledge from their university studies on some of the Biodiversity concepts covered in CAPS. All the participating teachers indicated that the Fundisa for Change continuing teacher training programme changed their teaching practices in that they gained new scientific knowledge, and their teaching and assessment strategies also improved (refer to section 4.3.4).

Politics and educational administration, as part of the meta-practices, play a major role in the culture of the school. This talk of a new curriculum, which is CAPS, is the result of the political decisions of the current government, and the fact that some schools have inadequate infrastructure, or do not have enough equipment, textbooks or furniture, has to do with funding and resource allocation falling under educational administration.

5.3 Conclusion

This chapter involved Step 1 of the abductive phase in the analysis of the Biodiversity lessons. The theory of practice architectures was used to analyse these Biodiversity lessons the participating teachers presented when completing their portfolio assessment task. The characteristic sayings, doings and relatings in the teaching of Biodiversity by the participating teachers were looked at together with the conditions which enabled or constrained their teaching of Biodiversity as a practice. In this chapter, it was evident that the teaching of Biodiversity as a practice is characterised by a special type of a language consisting of scientific terms such as classification, ecosystems, biomes, adaptation, abiotic and biotic factors, to mention a few. Teaching Biodiversity is also characterised by certain teaching methods such as fieldwork, group-work and practical investigations. The teaching of Biodiversity is enhanced by sound relations between teachers and learners, and among learners themselves. It can also improve people's attitudes towards the environment. The training of teachers alone is not enough, the conditions enabling or constraining the teaching practice such as teaching resources, infrastructure, policies and teacher support need to also be considered. Step 2 of the abductive data analysis process which uses the theory of the ecologies of practices is presented in the next chapter.

CHAPTER 6: TEACHING BIODIVERSITY: A LIVING OR NONLIVING ENTITY?

6.1 Introduction

This chapter presents and analyses the research results by using the theory of ecologies of practices, serving as the second part of the abductive process of the data analysis. An attempt is made here to show the living nature, if any, of the teaching of Biodiversity and the related practices of teacher learning, teacher training and assessment. The living nature of practices is portrayed by displaying the principles of living systems as explained in section 2.2.2.2, and by showing the relationality between the practices. This helps in answering Question 4 of this study. It should be noted here that explaining these characteristics was not an easy task as they are related to one another, and closely intertwined.

6.2 Characteristics of teaching Biodiversity as a practice

This section presents evidence on the nature of teaching Biodiversity and its associated practices which are looked at in terms of the characteristics of living systems they are thought to possess.

6.2.1 The ability of teaching Biodiversity practice to network with others

Practices exist due to their nature of being connected to one another as explained in section 2.2.2.1.1. From the evidence provided, the training was conducted in such a way that teachers were gaining content knowledge (through teacher learning) as seen in section 4.3.3.5.1. TT 01 indicated that “*one of the things that teachers don’t know, [is that] they don’t have the knowledge. They don’t have the environmental knowledge*” (TT 01-I, paragraph 22). This serves as one of the reasons for running Fundisa for Change teacher training. It also shows how teacher training and teacher learning are networked or connected to each other. TT 01 further described how in one of his training sessions he took teachers on a field trip to “*experience reality*” and “*to see what are the threats to the Biodiversity in that area as well, which is part of the curriculum*” (TT 01-I, paragraph 26). In this case, TT 01 brought in an element of how the teaching of Biodiversity which is based on school curriculum connects to teacher learning and teacher training. ECT 04 remembered some of the new terms she learned saying “*... we were taught about the Biomes*” (ECT 04-I, paragraph 175).

The Fundisa for Change training does not only focus on subject content knowledge but also on teaching methodology as shown in section 4.3.3.5.2. As TT 02 indicated “*Fundisa encourages teachers to use methods that involve learners more and can make learners experience what they learn. These methods include role-plays and excursions to mention a few ...*” (TT 02-I, paragraph

15). This is done in an attempt to transform teachers' teaching practices as TT 02 observed that "most teachers still use a lecture method when teaching, and this does not really involve learners in the process of teaching and learning" (TT 02-I, paragraph 15). From the interviews she conducted in her PhD study, TT 02 found that teachers actually used the teaching methods they were exposed to during the training (TT 02-I, paragraph 15).

ECT 04 indicated how the way the training is conducted relates to how she learns and how this impacts on her teaching practice and student learning:

... if they [Fundisa for Change] gonna teach about something, they take you to the Environment that they are gonna teach about, let you touch whatever you're going to be taught about ..., they take you as a learner, in those trainings for Fundisa for Change Because whatever you need to do with your own learners, then that's what they teach you to do, so that when you go back to school, you exactly know what is it that you need to do with your own learners, how you can make them interested in this lesson, how you can make them understand. (ECT 04, paragraph 192)

The other focus area in the Fundisa for Change trainings is the assessment as shown in section 4.3.3.5.3. As has been stressed, "teachers are made aware to align assessment with their teaching methods" (TT 02-I, paragraph 16). This shows the connection between teacher training, teacher learning and assessment. These networks are shown in the form of lines connecting these practices as shown in the figure that follows.

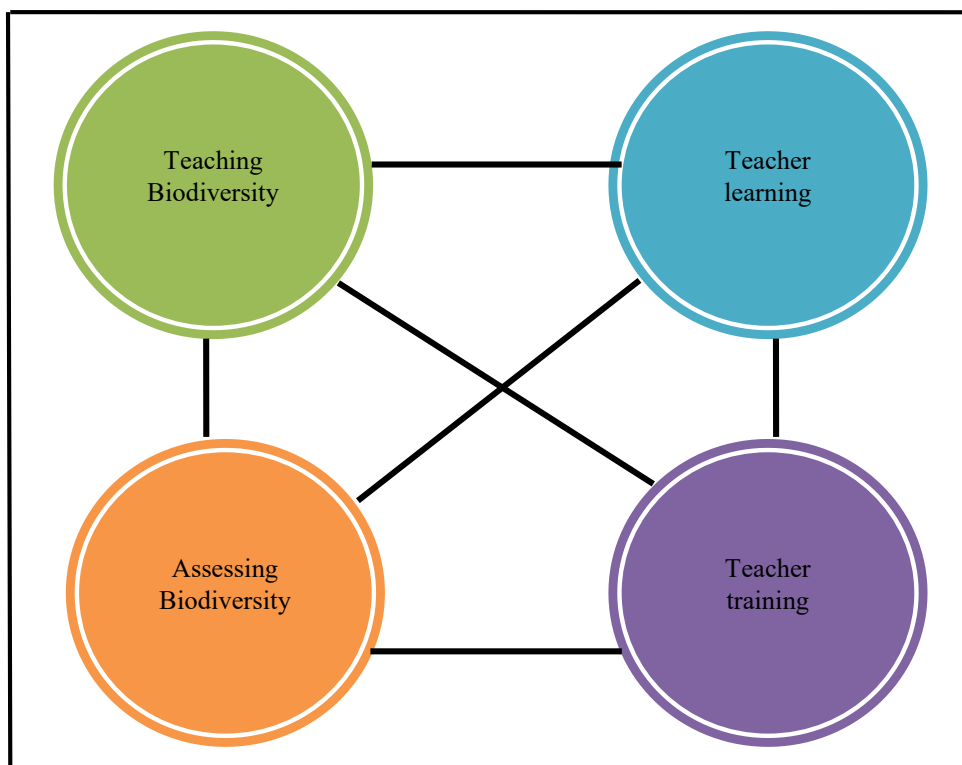


Figure 6.1: Networks between practices associated with teaching Biodiversity

6.2.2 The nested nature of teaching Biodiversity practice and its associated practices

Practices as living systems exist at different levels, some being at higher levels than others, and there is therefore a possibility for some to be contained or nested in others. Smaller practices contribute to the function of the larger ones as section 2.2.2.1.2 shows. In the case of the practices being looked at in this study, some evidence is presented to substantiate this claim. TT 01 alluded to the fact that in the Fundisa for Change training, teachers are helped to work with their textbooks as this is “*what they had to work with to teach, and then work with the Fundisa texts to kind of like know the subject, improve your teaching practices and improve your assessment practices* (TT 01-I, paragraph 24). The implication here is that the practice of teacher training is the one that occupies the highest level as the remaining practices are influenced by it, and as teachers are trained, they learn by gaining new content knowledge and improving their teaching and assessment skills. The way the teachers are trained influences the way they learn and this will also affect the way they teach and assess. ECT 04 and ECT 07 indicated that in the Fundisa for Change training, they learnt that assessment needs to be thought about prior to the presentation of the lesson, something they were not previously aware of (ECT 04-E, ECT 07-E). TT 06, when talking about the early years of conceptualising the Fundisa for Change programme, noted that the discussions were on “*how our starting point should be CAPS, and how that needed to bring in the concept of transformative learning; what kind of content, and how that had to be informed by what the CAPS was saying and what the CAPS was looking at*” (TT 06-I, paragraph 20). This further explains how teacher training which relies on what is contained in CAPS, is influencing teacher learning. The figure below demonstrates the nested characteristic of these practices.

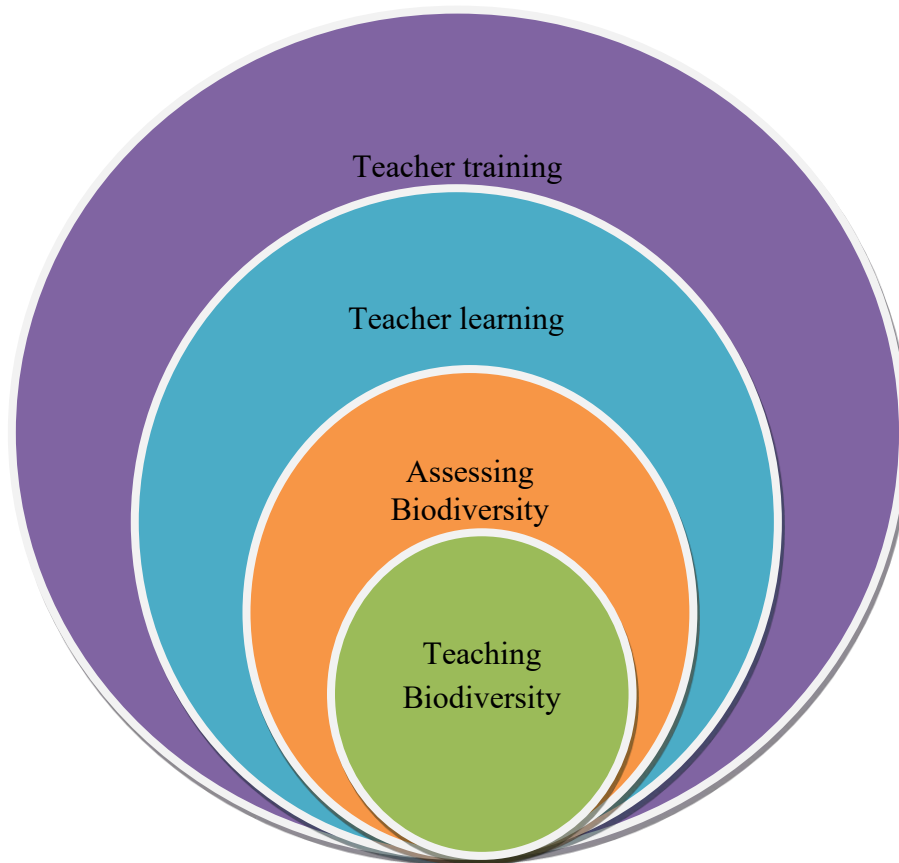


Figure 6.2: Nested nature of practices associated with teaching Biodiversity

6.2.3 The interdependency between teaching Biodiversity and its associated practices

The teaching of Biodiversity needs other practices to realise its purpose. An attempt is made here to establish whether there is any interdependency between the teaching of Biodiversity as a practice and the practices of teacher training, teacher learning and assessment of Biodiversity. TT 02 emphasised that as a result of the Fundisa for Change trainings, *“teachers became more confident now that they had more content knowledge, and skills on teaching and assessment had improved, and in that way they could realise their personal and professional identities”* (paragraph 36). This implies that as teachers are trained and they learn new content and they acquire new teaching and assessment skills, they have a sense of contentment as they realise that they can now do things in a better way than before the training. The improvement in subject content knowledge and the way they teach and assess is attributed to them having learnt what was presented in the training. In this case improving assessment and the teaching of Biodiversity depend on what teachers have learnt which is also coming from the way the training was structured and the content shared. The above statement by TT 02 also implies that there are other practices as well, such as personal growth and professional development which are dependent on teacher training and teacher learning. The statement also reveals one of the characteristics of living practices, which is that of development,

as teachers grow as individuals and as professionals. This will be elaborated further in the sections that follow.

TT 01 explained that the idea behind the Fundisa for Change training is that the teachers are trained to know more than what they are supposed to teach “ *so that they could understand the topic better, and then be able to teach the topic informed by pedagogy, that included the concepts in the local environment and the testing of those concepts ... in terms of what the curriculum wanted* (TT 01-I, paragraph 24). This echoes the idea that a more knowledgeable teacher is better informed in terms of what teaching methods to use for a given topic and what assessment strategies to use. Students can perform well if they are assessed properly; if the assessment is incorporated into the teaching process; and if the teacher is well informed on the topic as was shown in section 2.4.2.2. Assessment and teaching are therefore interdependent, and teacher training and teacher learning are also interdependent. Fundisa for Change trainings, as TT 01 indicated earlier, are influenced by CAPS curriculum, which spells out the forms and types of assessment to be administered, and the content knowledge to be taught. Therefore, the teaching of Biodiversity, assessment, teacher training and teacher learning are dependent on each other, as illustrated in the figure below.

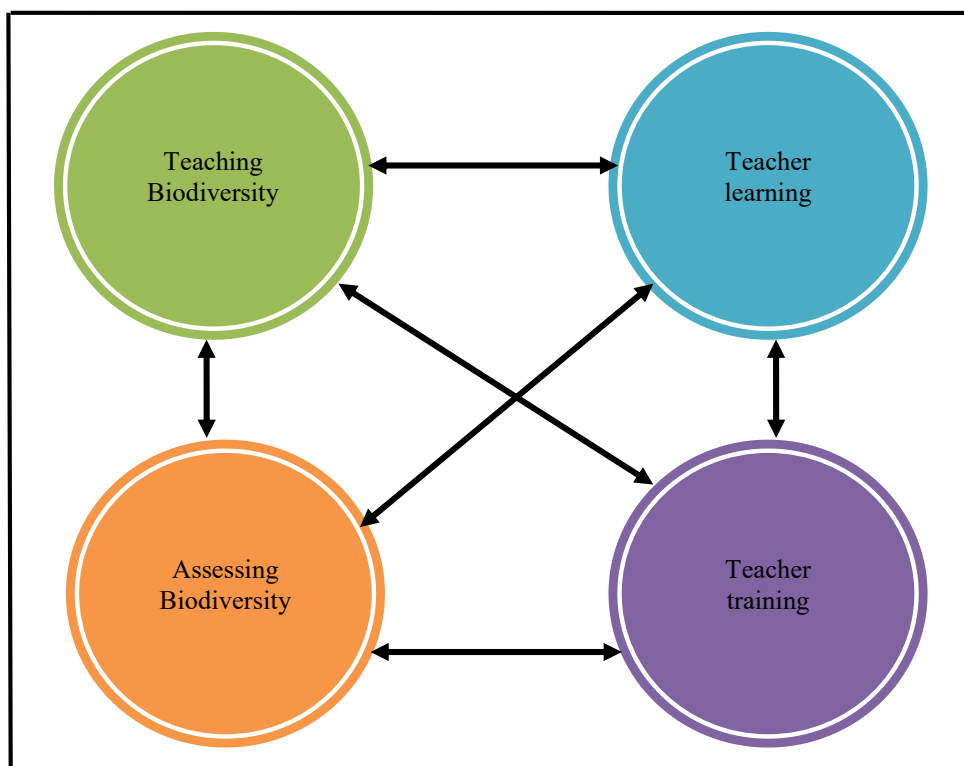


Figure 6.3: Interdependencies between practices associated with teaching Biodiversity

6.2.4 The diverse nature of teaching Biodiversity and its associated practices

It was explained in section 2.2.2.1.4 that different parts of a system in an ecosystem have different tasks, all working towards achieving a common purpose. Figure 6.3 above shows the different practices associated with the teaching of Biodiversity and how they are connected to each other even though they have different roles to play. Each of these practices is meant to contribute to the overall task of the whole system, which in this case is student learning. The teaching of Biodiversity as a practice is also a system of smaller practices such as reading, writing, demonstrating, discussing, role-playing and engaging in fieldwork. The Fundisa for Change training programme exposes teachers to a wide variety of teaching and assessment methods for them to make informed choices when it comes to deciding which teaching or assessment method to use, to cater for different learning styles. ECT 06 talked about one training session she attended that was organised by the Department of Education where the trainees simply sat and listened to someone talking from power-point slides, and as a result she did not enjoy the session (ECT 06-I, paragraph 243). MPT 03 talked about the importance of using different teaching methods:

It was only after the workshop, that I started understanding that I have to use this method. Then maybe like in one lesson, one topic, I can teach with this method then the following day I can apply this one, so that there should be ... learners should be interested in the lesson because most of the time, we do presentation ... (MPT 03-I, paragraph 334)

The importance of using different forms of assessment to cater for different learners was also highlighted in section 4.3.3.5.3. This shows that it is possible to explore different assessment strategies if some do not yield the expected results in an effort to improve learner performance. The levels of questioning are also diversified with the same purpose of addressing different learners and their cognitive levels. When teachers are preparing for their lessons they are encouraged to use different sources of the information and not only rely on their textbook as the knowledge contained in the textbook might sometimes be outdated. MPT 02 is one of the teachers who indicated that she used different sources of knowledge to prepare for her lesson (section 5.2.5).

6.2.5 The cyclical nature of teaching Biodiversity and its associated practices

The teaching of Biodiversity is made easy and possible as a result of teachers having been exposed to training, but not all teachers who teach Life Sciences are able to participate in training. Teacher trainers are trained in the programme to provide a pool of trainers who are able to run teacher training in their areas or institutions. As TT 06 put it,

... we've put an effort also into ... into partners, and supporting partners' capacity and then opportunity for them to work with teachers. So it was to capacitate partners and then give partners the opportunity and a couple of people from teacher education institutions to do that multiplier effect, because they work directly with teachers. (TT 06-I, paragraph 134)

TT 06 went further, indicating that she was also a teacher educator herself, but she had to be trained in the Fundisa for Change programme for her to be able to offer Fundisa for Change training: *“So I was a teacher educator, and then through the Fundisa program and going through all these processes, there was more capacity built in myself, and then I was able to run the Fundisa courses with teachers (TT 06-I, paragraph 138). TT 07 agreed that the training was appropriate for teacher trainers “with the understanding that they will have a multiplier effect on the teachers (TT 07-I, paragraph 141).*

Elaborating on the multiplier effect idea, Fundisa for Change recommends that the teachers who attend the training train their peers in their schools or during their cluster meetings, and this is the reason the subject advisors are invited to attend training with the teachers. As TT 05 explained, *“If we have the subject advisor attending, then they can run or do the reporting together with that particular teacher who had attended to the rest of the group. They can work together to share the information (TT 05-I, paragraph 210). Lead teachers are also targeted for training because of the same reason, as TT 02 shared: “if you are having a lead teacher trained, then it's easier for that teacher to go back with the subject advisor and do the workshop together (TT 02-I, paragraph 211). This is also the reason why Fundisa for Change advocates for the establishment of professional learning communities as described in section 4.3.3.6. TT 03 indicated that a solid foundation for Fundisa for Change has been laid, which is basically the developed materials, and now “we want the community of practice to use those materials and to have access to them. So it's this idea of, you know, putting the building blocks in place in a collaborative way and then allowing for the partner organisations to take them up and be able to use them (TT 03-I, paragraph 32). This means that people might come in and out of the community of practice but it is always going to be there through the resources that have been produced, and even as new people come in they will be trained and informed of the Fundisa for Change mandate. The same will happen with teachers that sometimes find themselves being moved to different subjects or to different schools after training as more training is run from time to time to accommodate new teachers. The activities of the Fundisa for Change programme are therefore sustained as new groups are trained and those trained implement the skills acquired.*

6.2.6 Matter flows in the teaching of Biodiversity practice

The flow of matter, which in this case refers to the skills, the knowledge, the attitude and the values, from the trainers to the learners through the teachers is expected to happen in order to realise the goal of teaching Biodiversity. As was mentioned in section 4.3.3.5, the training addresses the challenges teachers are facing when implementing the curriculum. As teachers pass on what was learnt in the training (refer to sections 4.3.3.5.1, 4.3.3.5.2 and 4.3.3.5.3) to their peers in their subject, departmental or cluster meetings, “matter” or “energy” flows through the system. Taking what was learnt from the training into the classroom, TT 02-I (paragraph 192) commented that

Some teachers were saying that the way we dealt with certain concepts in the training enabled them to do the same in their classrooms. They would say: ‘The way you did this case study, I was able to go and do it that way’. That’s more of them being able to get more confidence to work with those concepts, which they did not have when they started the training.

Other practices that are connected to the teaching of Biodiversity also benefit as shown in the previous sections through this flow of matter in the ecosystem of practices. It is therefore possible to improve assessment and teaching practices through training.

6.2.7 The development of teaching Biodiversity as a practice

As teachers are trained they develop as individuals and as professionals. Teachers develop in terms of gaining new content knowledge, learning new teaching and assessment methods, and positively changing their attitudes and values, with the hope that learner performance will be improved. Section 4.3.4 showed that the participating teachers gained new Biodiversity content knowledge, new teaching methods and new assessment methods from the training they attended. Some teachers’ attitudes towards the environment improved (TT 02-I). This was also instilled in learners as MPT 05 indicated that the training made her find “*ways easily to make learners ... have the love of nature*” (paragraph 423). MPT 02 indicated that she had never attended any CAPS training before, so the Fundisa for Change training was “*very fruitful*” (paragraph 302).

6.2.8 The ability of teaching Biodiversity practice to maintain a dynamic balance

There are challenges in the teaching of Biodiversity and the related practices. Some of these are shortage of teaching and learning resources, inadequate infrastructure, inadequate subject content knowledge among some teachers and lack of support for some teachers as elaborated in section 5.2. There are also conditions which nurture and support the teaching of Biodiversity practices which include training programmes like Fundisa for Change, cluster meetings and the support for some

schools from private companies (refer to section 5.2). Amid the challenges, there had not been a reported case of the teaching of Biodiversity practice being made impossible to unfold, implying that other practices supported it and kept it going. An example here is that of ECT 05 and MPT 01 who did not know how to use different teaching strategies in their lessons (refer to section 4.3.3.5.2) and ECT 06 who was not assessing students according to CAPS requirements (refer to section 4.3.3.5.3). Section 5.2.9 gives a summary of the conditions that constrain and enable the teaching of Biodiversity.

6.3 Conclusion

This chapter displayed the general characteristics of practices that make them living social systems, as portrayed by teaching Biodiversity practice using the data collected. These characteristics are networks, nested nature, interdependency, diversity, cyclical nature, flow of matter, development and dynamic balance.

The evidence of the interrelationships among the practices of teaching Biodiversity, teacher training, teacher learning and assessment was also looked at from the data collected in order to answer Question 4. The next chapter discusses the results presented and analysed in Chapters 4 and 5, and in this chapter, and makes a case for this research study's contribution to new knowledge. Conclusions are drawn from these discussions and recommendations resulting from the discussions, and recommendations for further research, are then offered.

CHAPTER 7: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This chapter synthesises the results presented in Chapters 4, 5 and 6. The discussion draws on data presented in Chapters 4, 5 and 6 and the ideas emanating from the literature review presented in Chapter 2. The discussion is in the form of analytical statements related to the goals and research questions in the study. Conclusions are drawn from the discussion, and recommendations are made regarding the main findings. Recommendations for further research are presented. The chapter also highlights the contribution this research study makes to existing knowledge.

7.2 Analytical statements

The discussion is based on the following analytical statements:

1. The participants' subject content knowledge improved.
2. The participating teachers' knowledge and use of teaching methods in teaching Biodiversity improved.
3. The participating teachers' knowledge and use of assessment methods in teaching Biodiversity improved.
4. The participating teachers were appreciative of the way the training was run.
5. The Fundisa for Change continuing teacher training programme portrays effective teacher training programme characteristics in terms of:
 - 5.1. Duration
 - 5.2. Active involvement of teachers
 - 5.3. Providing teachers with subject content knowledge
 - 5.4. Promoting establishment of professional learning communities
 - 5.5. Coherence
 - 5.6. Follow-up
 - 5.7. Assessment of teachers
6. Discursive arrangement: Language is a challenge in teaching Biodiversity practice.
7. Material economic arrangement: Inadequate infrastructure, furniture, teaching and learning support materials are a challenge in some of the participants' schools.
8. Socio-political arrangement: Policy requirements are sometimes based on ideal situations, thereby creating problems for teachers when teaching.

These analytical statements are discussed below.

7.2.1 Analytical statement 1: The participants' subject content knowledge improved

All the participating teachers indicated that they had gained new Biodiversity content knowledge as shown in Table 4.15. This new content knowledge was gained from the following concepts: Biomes, Ecosystems, Taxonomy, Biodiversity and Human-environment relationships as the teachers were participating in the Fundisa for Change teacher training workshop. This finding is in line with what was discussed in section 2.3, the fact that studies in Environmental Education have shown that there is an environment and sustainability content knowledge gap among some teachers in South Africa. As Bantwini (2012) said, "One of the many challenges experienced is that the majority of the few qualified science teachers still suffer inadequacies in their pedagogical and science content knowledge" (p. 518). Similarly, Isaacs (2016) in her case study involving three Grade 7 Natural Sciences teachers found that these teachers had inadequate knowledge on how to teach the newly introduced Biodiversity content in the CAPS curriculum. This was due to their limited knowledge regarding Biodiversity content which they only learnt about during DBE training workshops (Isaacs, 2016). Isaacs's (2016) study was about investigating the participant teachers' "knowledge of biodiversity, what they believed and valued about biodiversity, and why they taught biodiversity in the way they did". As discussed in section 2.4.2.2, inadequate subject content knowledge leads to an inability to choose proper teaching and assessment methods, thereby negatively affecting teaching practice. Jita and Ndlalane (2009) in their study involving 120 Mpumalanga teachers who were teaching Maths, Biology, Physical Sciences and Agriculture, made the following findings among the Biology teachers: "poor organisation of facts; misconceptions relating to the concept of photosynthesis; and a general lack of appropriate content knowledge about the topics under discussion" (p. 61). ECT 05 confirmed that Fundisa for Change training "*enhanced*" her subject content knowledge while ECT 04 indicated that she "*had no prior knowledge about Biodiversity*" (refer to section 4.3.4.1). There is a need for teachers to continuously keep up with current knowledge and debates in their subject areas due to the changing nature of knowledge, especially environment and sustainability content knowledge which is highly debatable (CT, p. 8; Songqwaru, 2012).

7.2.2 Analytical statement 2: The participating teachers' knowledge and use of teaching methods in teaching Biodiversity improved

The following teaching methods were commonly used by the participating teachers in their classrooms: fieldwork, group-work, practical work, teacher-centred, question-and-answer, textbook and discovery methods, as displayed in Table 4.16. The most common teaching method used was the teacher-centred method. This is a type of learning that Jickling et al. (2008, p. 7) called the

transmissive method, in which the teacher is the main player and performs an authoritarian role (refer to section 2.3.1). This is not the type of method recommended in teaching science. Life Sciences, as a science subject, has certain recommended teaching methods, particularly for environment and sustainability subject content that teachers can use to share knowledge and skills with learners. These teaching methods are experiential, investigative, learning by doing and deliberative methods (refer to sections 4.3.1.1.2).

Most of the participating teachers (ECT 04, ECT 05, ECT 06, ECT 07, MPT 01 and MPT 02), as Table 4.19 shows, indicated that they had gained new ideas on how to use fieldwork as a teaching method. MPT 02 stated that before attending the Fundisa for Change training, she “*did not know much about fieldwork*” (MPT 02, paragraph 179). ECT 05 said she learnt that the teacher should first “*teach them [the learners] inside [the classroom] and then [take them] outside to the environment, and identify things, ... at a later stage they will know and understand ... when you evaluate them or do an assessment on them*” (ECT 05-I, paragraph 218). As the Core Text indicates, “*fieldwork methods are particularly well suited to Science*” (CT, p. 11). Fieldwork is not only important because it is suited to teaching science, but there are also other important aspects that eventually benefit the learner. These important aspects of fieldwork include holistic education, experimental discovery, personal development, social learning, aesthetic development, concept development, skill development, physical development, relevance and enjoyment, as discussed in section 2.3.1. Anderson, Thomas and Nashon (2009) further stressed the importance of fieldwork saying that “visits to natural ecological settings provide enjoyable, rich, authentic and salient real-life experiences that can enhance biology learning” (p. 512).

The second most common teaching method that the participating teachers gained new insights about is the learner-centred method (refer to Table 4.17). This form of teaching is also called transformative teaching (refer to section 2.3.1), as learners are involved in the process of teaching and learning. One of the characteristics of this method is that the learners’ prior knowledge is important in shaping the lesson and dealing with alternative conceptions. Prior-knowledge is restructured as the new knowledge is gained. If learners are given an opportunity to convey what they commonly know and believe about certain phenomena, a platform is created for discussion. By doing this, learners get to realise why their views might be scientifically wrong without thinking of science undermining their belief system. In this way the friction between science and the learners’ belief system is minimised, hence the learners’ interest in science can be developed. Lambert and Walker (1995) said that “learners bring experience and understandings to the classroom. Thus they do not encounter new information out of context, but rather apply what they know to assimilating

this information; or they accommodate or reframe what they know to match new understandings they have gained” (p. 17). Brewer and Chinn (1998) indicated that “most researchers agree that prior knowledge has powerful effects on the learning process” (p. 104). As ECT 05 indicated, Fundisa for Change training emphasises that “*you ... need to know what they [learners] understand*” (ECT 05-I, paragraph 475). Other teaching methods in which the participating teachers gained more knowledge included case studies (MPT 03), investigations (MPT 01), solitaire and role-play (ECT 05), and round-robin (ECT 06).

Improvising in cases where there is a shortage of equipment or financial resources was highlighted by some participants (ECT 05, ECT 07 and MPT 04) (refer to section 4.3.4.5) as a valuable learning opportunity developed from some of the training activities, for example classification using shoes or books which were readily available. Owolabi and Oginni (2012) indicated that improvisation allows a “teacher to think of cheaper, better and faster methods of making teaching learning process easier for students” (p. 45). MPT 01 used beads instead of live animals in her class to estimate population size because beads were readily available and because she feared that learners might mishandle live animals (refer to section 5.2.4). The participants also realised the importance of starting in a local area for fieldwork before taking long trips which are in most cases costly, time-consuming and require much effort for preparation. In fact in the Biodiversity lessons presented, all the participating teachers, except MPT 01, took learners out into the school grounds for their practicals. As ECT 05 indicated in section 4.3.4.5, “*you can do it [fieldwork] within the school premises*” (ECT 05-I).

Chitsiga’s (2016) research study involving two Grade 11 Life Sciences teachers which looked at teaching methods promoting “active and critical learning”, and how these methods were enabled and constrained, concluded that the new environmental knowledge in the CAPS curriculum and the inadequate information sources, were some of the challenges teachers were facing. The teachers were however able to improvise their resources to enable the teaching practice and she recommended “ongoing teacher refresher workshops on the environmental content in the CAPS curriculum” (Chitsiga, 2016).

7.2.3 Analytical statement 3: The participating teachers’ knowledge and use of assessment methods in teaching Biodiversity improved

The formal assessment methods prescribed in the CAPS document that teachers use as explained in section 4.2.3, are tests, practicals, examinations and assignments or projects. It is however crucial that informal assessment opportunities are offered to learners to prepare them for formal assessment.

The participants indicated having learnt that it was very important to give learners as many different informal assessment tasks as possible in order to identify the gaps in learners before administering formal assessment (ECT 04, MPT 01, MPT 03 and MPT 04) (refer to section 4.2.3). As Ogan-Bekiroglu (2009) indicated, informal assessment tasks “guide improvement throughout the learning process, instead of waiting to give feedback at the end of instruction” (p. 2).

As was described in section 4.3.1.2.1, assessment methods used depend on the subject content covered and the skills learners were meant to achieve at the end of the teaching and learning process. These assessment methods are also linked to Life Sciences Specific Aims. Ogan-Bekiroglu (2009) noted: “Considering that enhancement in instruction and learning improvement are among the purposes of assessment, assessment should reveal what students know and be able to do as well as determine the skills they need to work on” (p. 3). ECT 07 indicated that she was not taking the issue of assessing skills into consideration before she came to Fundisa for Change training (refer to section 4.3.4.3). The other important factor in assessment is the structuring of the assessment task such that it caters for different cognitive levels of understanding in learners (refer to section 4.3.3.5.3). TT 02 said: *“In terms of assessment, teachers are trained on how to set assessment tasks that incorporate all the different cognitive levels as stipulated in CAPS”* (TT 02, paragraph 16). This is the idea echoed by ECT 04 and ECT 06, who indicated that they were not aware of this until they attended the Fundisa for Change training (refer to section 4.3.3.5.3).

The participating teachers learnt that assessment methods should be closely linked to the teaching method used. Therefore, assessment shapes the implementation of the lesson. This was a new idea welcomed by ECT 04 and ECT 07. There are three assessment strategies that the participating teachers said they gained new knowledge about and were now confident to use. These were practicals (ECT 06, ECT 07 and MPT 03), case studies (MPT 01 and MPT 03) and work-sheets (MPT 05) (refer to Table 4.21).

7.2.4 Analytical statement 4: The participating teachers were appreciative of the way the training was run

The participants commended the Fundisa for Change teacher training programme for the training they attended (refer to Table 4.20). All participants, except MPT 02, spoke highly of the trainers. The following are some descriptions of their trainers (refer to section 4.3.4.4):

- *Passionate* (ECT 04 and MPT 04);
- *Well prepared* (ECT 04, ECT 05, ECT 06, ECT 07, MPT 01, MPT 04 and MPT 05);
- *Enthusiastic* (ECT 04);

- *Experts* (ECT 05);
- *Knowledgeable* (ECT 07);
- *Clear* (ECT 07);
- *Friendly* (MPT 01 and MPT 05);
- *Professional* (MPT 01);
- *Offering assistance* (MPT 01);
- *Impressive* (MPT 03); and
- *Perfect* (MPT 05).

This is an indication that the participants were happy with the way the trainers conducted themselves and ran the training. The success of a professional development programme depends on the trainers or facilitators as they are the ones entrusted to run the activities of the programme. Molle (2013) indicated that “scholars have identified facilitation as one of the key elements in any professional development system” (p. 197). She further asserted that “facilitators are viewed as essential because they structure and guide the learning experience of the participants in a professional development initiative” (*ibid.*). The participants described the presentations as “*good*” (ECT 07) and “*interesting*” (ECT 06, ECT 07 and MPT 04). Other descriptions of the Fundisa for Change teacher training were “*good, actively involving*” teachers with “*interesting activities*” (ECT 07), “*enjoyable*” (MPT 01), “*all perfect*” (MPT 02) and “*worthwhile*” (MPT 04). These comments show a high level of satisfaction from the teachers about the training which implies that their expectations about the training programme were likely to have been met.

The other aspect of the training that the participating teachers liked was the availability of the resources they used as reference material to help improve their practice (refer to section 4.3.4.4). All the participating teachers were appreciative of this as was indicated in section 4.3.4.4. ECT 07 said: “*Some books ... are very good. Yes they helped me in understanding most of the things on Biomes, because there are many ... books that I have*” (ECT 07-I, paragraph 378). ECT 06 added: “*I use them [the books] to prepare lessons, or maybe to use ... like the method that is suitable*” (ECT 06-I, paragraph 468). MPT 04 also indicated that in the training, they were given “*a lot of books that talk about Biodiversity*” (MPT 04-paragraph 404). The materials given were described by the participating teachers as helpful (ECT 05, MPT 03 and MPT 05); motivational (ECT 05); informative (ECT 07); “*insightful*”, “*a must-have*” and “*heaven sent*” (MPT 01); and “*very useful*” (MPT 02).

The sentiments shared above resemble those of Songqwaru's research participants trained during the piloting of the Fundisa for Change programme when they commented about the usefulness of the resources received during the training and the skills and knowledge of the trainers (Songqwaru, 2012, pp. 118-120). These comments could be an indication of improved motivation levels among these teachers when it comes to teaching Biodiversity. Tshiningayamwe (2011, p. 105) indicated that when motivated teachers develop a love for the subject they work even harder under difficult conditions. This could be the reason why MPT 04 decided to use empty plastic bottles during the experiment instead of simply teaching the lesson on water retention without doing an experiment due to lack of equipment at school (refer to section 5.2.7).

7.2.5 Analytical statement 5: Fundisa for Change continuing teacher training programme portrays effective teacher training programme characteristics

The characteristics of effective continuing teacher professional development initiatives were discussed in detail in section 2.4.2. These characteristics or features are also shown in Figure 2.2. Different terms are used to describe these features of effective professional development initiatives. Steyn and van Niekerk (2005) called them "critical success factors" (p. 142); Archibald et al. (2011) called them "high quality" (p.3) features; Desimone (2009) called them "critical" (p. 183) features and also "core features" (Desimone, 2011, p. 69). A look at the Fundisa for Change programme and what the participating teachers said about the programme (refer to section 4.3.3) enabled identification of the characteristics discussed below.

7.2.5.1 Duration

In Mpumalanga two training sessions were run for three and half days and in the Eastern Cape for two and half days. Looking at the training workshop programmes (Appendices R and S), it is evident that the days were fully utilised, with a full day running from 08h00 to 17h30 and some teachers even scheduled activities during the evenings. Commenting on the amount of time for training, MPT 04 said: "*we had enough time, because we started early in the morning up until 5[p.m.]. Then we did everything that we wanted to do, even the content, they got into the content in detail, it's given in detail because they've got enough ... they had enough time ...*" (MPT 04-I, paragraph 218). As MPT 05 indicated, a longer training session is important because "*you do need time to grasp whatever thing was being taught*" (MPT 05-I, paragraph 398). Even though the time seemed to be enough for MPT 04 and MPT 05, MPT 03 indicated that the amount of work covered in that period was "*very strenuous*" (MPT 03-I, paragraph 311). MPT 02 agreed with MPT 03 by saying that "*it was so strenuous when we were attending the workshop because we started at 8 o'clock until 6 and then you had to write an assignment, and you had to present tomorrow*" (MPT 02-I, paragraph 268).

This means that for MPT 02 and MPT 03, three and half days were still not enough, considering the amount of work they were faced with. However, the important point here is that the training sessions were run over a number of days, and this gave teachers time to digest the information gained and also to ask questions for clarification if required (refer to sections 2.4.2.1 and 4.3.3.7). This period also gave them a chance to get to know each other and network together. Steyn and van Niekerk (2005) advised that professional development of teachers should be carried out over a longer period of time as “quick fixes” will never yield the desired outcome (p. 142). Learner performance as indicated by the mark-scores showed that the training was successful in achieving the outcomes.

7.2.5.2 Active involvement of teachers

The Fundisa for Change training provided platforms for teachers to engage actively with one another in activities. This was evident when teachers worked in groups to share their knowledge, experiences and skills. They also had the opportunity to go on a field trip, as ECT 06 and MPT 01 indicated in section 4.3.3.1, to actively engage with the living and the nonliving things. This is also shown in Appendices R and S. Teachers were further involved in testing some of the skills they learnt, such as using different methods of teaching and assessing as ECT 04 indicated in section 4.3.3.1. As teachers were involved in dialogue and discussions, new knowledge was being constructed. Desimone (2009), Steyn and van Niekerk (2005) and Archibald et al. (2011) mentioned active participation as one of the characteristics of effective teacher professional development initiatives (refer to section 2.4.2).

7.2.5.3 Providing teachers with subject content knowledge

One of the main focus areas of the Fundisa for Change training was the Biodiversity content knowledge. As has been noted, this was to minimise the teachers’ subject content knowledge indicated in earlier research (Lotz-Sisitka, 2011; Songqwaru, 2012; and Fundisa for Change Programme, 2013) (refer to sections 2.4.2.2). The Fundisa for Change programme also develops teaching and learning support materials that teachers can use for references in their teaching (refer to section 4.3.1). Participants indicated that their knowledge on Biodiversity concepts improved (see sections 4.3.3.5.1 and 4.3.4.1). Subject content knowledge is cited by Desimone (2009) as the most important feature of effective professional development programmes, as the teacher with more content knowledge will have more confidence and better ways of teaching which will, to some extent, also lead to improvement in learner performance (p. 184). Songqwaru (2020) in her evaluative case study during which she worked with Fundisa for Change programme partners, funders, facilitators and trained teachers across five provinces in South Africa, aimed at explaining the theory of change used in conceptualising and implementing the programme. She indicated that

the Fundisa for Change programme was conceptualised on the assumption that “participants had inadequate environment and sustainability content knowledge to strengthen the teaching and learning of environment and sustainability content knowledge specified in the national school curriculum (Songqwaru, 2020, p. 393). This meant that a core aim of the Fundisa for Change teacher training was to provide teachers with this content knowledge, and equip them with how to teach and assess it (*ibid.*).

7.2.5.4 Promoting establishment of professional learning communities

The Fundisa for Change teacher training programme encourages the trained teachers to network in order to help each other on matters relating to their professional development, as TT 01 indicated in section 4.3.3.6. This could be particularly beneficial to newly qualified teachers due to lack of teaching experience; MPT 01 indicated that she had “*a lot to learn*” (refer to section 4.3.3.6) and she was thankful to meet experienced teachers in the training and they shared contact details for further networking. ECT 06 was also eager to share the knowledge with other Life Sciences teachers at her school. The spirit of collaboration among the teachers was also improved; MPT 02 also added that they were working together and exchanging ideas during the training (refer to section 4.3.3.6). As Steyn and van Niekerk (2005) noted: “Teacher collaboration and support are required for PD [Professional Development] to be effective” (p. 140). Desimone (2009) (see section 2.4.2.4) talked of collaboration among teachers as a powerful learning method.

Tshiningayamwe (2016) in her case study involving three Professional Learning Communities (PLCs) in South Africa initiated by Life Sciences teachers who attended Fundisa for Change Teaching Biodiversity training, reported that her research participants regarded subject content knowledge, teaching practices, assessment practices, and the teaching and learning support materials (what she called valued functionings) highly. Collaboration among the PLC members and good facilitation skills displayed by Fundisa for Change teacher trainers are some of the important factors that promote Teaching Biodiversity practice (Tshiningayamwe, 2016). Songqwaru (2020, p. 394) also indicates that in the Fundisa for Change trainings she observed, some activities involved group-work, during which teachers freely talked about their experiences so that they could be advised accordingly. The importance of this collaborative work was that the teachers were able to gain knowledge and skills, and their attitudes, values and perceptions were challenged to change as they revisited “their roles in relation to environmental teaching and learning” (*ibid.*).

7.2.5.5 Coherence

The Fundisa for Change continuing teacher training programme was established as a result of the development and implementation of CAPS in schools. It is therefore a programme meant to help teachers implement the new curriculum by providing them with environment and sustainability (in this case Biodiversity) content knowledge and the skills on how to teach and assess this content in order to improve their teaching practice, which eventually might improve learner performance (refer to section 2.4.2.7). Biodiversity content in CAPS and methods of teaching and assessing this were discussed in section 4.2. The Fundisa for Change programme strategy of training teachers to implement the Biodiversity section of the Life Sciences CAPS was introduced and discussed in section 4.3. The Fundisa for Change training is thus in line with CAPS requirements and also the teachers' needs in relation to addressing their teaching practice challenges (refer to section 4.3.3.5). Songqwaru (2020, p. 394) attested to this saying that,

Facilitators provided participants with resources, engaged them cognitively through presentations and on-course tasks. Content shared with participants was contextualized and aligned with the curriculum that participants were expected to implement. Relevance of the topic shared with participants enabled participants to see the value of the training in terms of supporting them with the professional work they do.

The environment and sustainability content in Life Sciences CAPS has also been formulated in such a way that it sensitises the learners about environmental problems, particularly anthropogenic ones, and proposes mitigation measures to lessen the impact (refer to section 2.3). A knowledgeable teacher has a multiplier effect and could play a major role in addressing the skills shortage in the environment sector and therefore help curb the environmental problems faced by the country. Among their objectives, South African National Biodiversity Institute (SANBI) and the Lewis Foundation (n.d.) proposed to: "Contribute to better science, mathematics, literacy and environmental learning in schools with adequate management capacity" (p. 54). As Desimone (2009) indicated in section 2.4.2.7, effective teacher professional development initiatives should address the country's policies. SACE also indicates that for professional development activities to be endorsed, they must be aligned with "identified system needs" meaning that they must show "relevance" or "appropriateness" (SACE, 2013, p. 14).

7.2.5.6 Follow-up

Follow-up is regarded by Steyn (2011) as an essential aspect of effective professional development initiatives as it gives an indication of what challenges teachers face in their teaching practice so that intervention strategies could be developed to support teachers and address the challenges (refer to

section 2.4.2.5). Following up on the trained teachers does not seem to be a clearly defined activity in Fundisa for Change training programme, even though the trainers (TT 01 and TT 02) highlighted its importance (refer to section 4.3.3.3). The trainers did however regard the portfolio assessment task that was given to the participating teachers as a form of a follow-up as teachers were asked to implement the ideas and the skills gained in the training, and they were also given an opportunity to reflect on the Biodiversity lessons they presented for assessment. MPT 05 confirmed that different communication methods were used to find out how they were doing, while ECT 07 and MPT 04 felt they could have a more structured and formalised follow-up (refer to section 4.3.3.3).

7.2.5.7 Assessment of teachers

Prominent researchers in continuing teacher professional development, such as Desimone (2009 & 2011), do not mention assessment of teachers as an important aspect of effective continuing teacher training programmes. However, this is an essential characteristic in the South African context due to the fact that any professional development initiative for practising teachers must have an assessment component for endorsement as required by SACE. As Steyn (2011) indicated, “all teachers registered by the South African Council of Educators (SACE) have to earn PD [Professional Development] points by attending accredited PD activities” (p. 44). It is therefore mandatory for practising teachers involved in professional development training to be assessed for them to be awarded certificates of achievement based on a point system after the training (refer to section 2.4.2.6). Assessment of teachers also served as a means to find out if learning did take place during training, and whether teachers were able to implement what they had learnt (section 4.3.3.2). SACE indicates that for professional development initiatives to be accredited, one of the criteria is based on teacher assessment, the main purpose of which is for teachers to demonstrate the skills acquired (SACE, 2013, p.14). The Fundisa for Change teacher training programme uses a portfolio of evidence as a means of assessing teachers.

7.2.6 Analytical statement 6: Discursive arrangement: Language is a challenge in teaching Biodiversity practice

None of the participants or learners in this study spoke English as their mother tongue. Two languages were spoken during the lessons: English and scientific language. It was however easier for teachers to explain difficult concepts by code-switching, meaning that a third language – the learners’ mother tongue – was also used (refer to section 5.2). Contrary to the common belief that the use of mother tongue language in teaching is due to teachers’ inability to fluently speak English it is in fact “a skilful and innovative way of enhancing effective communication” (Teik & Lian, 2013, p. 3). Teik and Lian (2013, p. 4) listed further advantages of code-switching:

- To facilitate and enhance students' learning
- To compensate for students' limited vocabulary / low proficiency
- To emphasise certain points
- To enhance solidarity between teacher and students
- To provide a conducive and non-threatening learning environment.

All teachers in the study were able to code-switch, thereby minimising this problem and making it a point that learners understood. Gqoloqa (2014), in her case study in which she worked with two Grade 11 Life Sciences teachers in East London in the Eastern Cape province to establish ways in which to help English second language learners understand Biodiversity concepts, found the language challenges to be about spelling issues, interpreting questions and differentiating between closely related Biodiversity concepts. The strategies that these teachers used to tackle these language issues included code-switching, breaking down the terms into different words and relying on prior knowledge for the construction of new terms (Gqoloqa, 2014). She recommended that teachers use a wide variety of teaching strategies to make learners understand the concepts but also stressed the importance of teachers attending training to acquire “foundational knowledge in Life Sciences” (Gqoloqa, 2014).

7.2.7 Analytical statement 7: Material economic arrangement: Inadequate infrastructure, furniture, teaching and learning support materials are a challenge in some of the participants' schools

Five schools in the study had functioning science laboratories while two did not (refer to section 5.2.9). Well stocked science laboratories, with teachers who know how to use the apparatus, have the potential to improve learner performance in science. Hofstein and Lunetta (2002) indicated that “laboratory activities have the potential to enhance constructive social relationships as well as positive attitudes and cognitive growth” (p. 35). This is an indication that the absence of a science laboratory or apparatus might impact negatively on the teaching and learning process. Three of the schools did not have a computer laboratory (refer to section 5.2.9). This is also a challenge to both teachers and learners as the use of technology is very important for many reasons in the teaching and learning process, one being ease of access to information (Yamagata-Lynch, 2003, p. 594). It is very time-consuming to write assessment tasks for learners on the chalk-board (as MPT 03 indicated in section 5.2.9) instead of having them typed out, especially if one teaches multiple classes.

The majority of participants did not have school libraries, and some of those who did said they were not well stocked (refer to section 5.2.9). The absence of libraries could have a negative impact on the process of teaching and learning as learners would find it difficult to supplement what they would have learnt in class or to find information when working on their assessment tasks. Teachers would also struggle to find information from different sources, leading to the teacher having a small range of information to share. As Kuhlthau (2010) indicated, “school libraries are an essential source of lots of information pertinent to the curriculum and good books to read” (p. 19).

Too many learners in a class was also a big challenge for most of the participants. Numbers ranged from 45 to 60 (refer to section 5.2.9). This situation sometimes results in disciplinary problems among learners as was the case in ECT 05’s lesson, where there were 76 learners in a class, some of whom were disruptive and decided to leave the class. Too many learners in a class also can prevent the teacher from using appropriate teaching and assessment methods, as MPT 03 indicated in section 5.2.6. MPT 03 and ECT 06 indicated that the space in their classrooms was so small that it was difficult for them to even move around in the classroom (refer to sections 5.2.2 and 5.2.6). This is clearly a problem in that less attention is given to the majority of learners and those learners who are far away from the teacher might not be able to get help. Ehrenberg, Brewer, Gamoran and Willms (2001) noted that “since it is easier to focus on individuals in a smaller group, the smaller the class size, the more likely individual attention can be given” (p. 1). Time is also a crucial factor in large classes as it takes time for the learners to settle down before the lesson starts, and it also takes considerable effort for the teacher to give regular feedback to the learners on their assessment activities. It is because of this problem that sometimes teachers use only the minimum assessment requirements to avoid long sessions of marking the learners’ work (Ehrenberg et al., 2001, p. 20). Tshiningayamwe (2016) and Gqoloqa (2014) highlighted large class size in their research studies as one of the factors negatively impacting on Life Sciences teaching practices.

The problem of learners having no books was experienced in two schools (refer to section 5.2.9). This meant that these learners were not able to access information from the textbooks or if the teacher gave out homework in which they had to refer to the book, it would be difficult for them to do it. This in the end would impact negatively on their Biodiversity learning. Chiappetta and Fillman (2007) indicated how important textbooks are saying that “at all levels of schooling Science textbooks are often used as the primary organizer of the subject matter that students are expected to master and provide detailed explanations of topics to be taught” (pp. 1847-1848).

All the points raised above affected or shaped the way the teachers presented their Biodiversity lessons. Some of these conditions cannot be controlled by the teacher. The schools in this study are public schools, getting funds from the government. For them to have laboratories, libraries, extra classrooms, furniture and textbooks, they rely on DBE to provide funding. As long as there is no intervention from the DBE, the situation is unlikely to change. Educational administration (the role played by DBE), as mentioned in section 2.2.4, is a meta-practice that affects the way the teacher eventually teaches Biodiversity.

7.2.8 Analytical statement 8: Socio-political arrangement: Policy requirements are sometimes based on ideal situations, thereby creating problems for teachers when teaching

At times DBE makes decisions that are difficult for the teachers to abide by because of the contextual factors prevailing in schools or even in DBE itself. A clear example is the mandatory requirement that each learner should have his or her own textbook (refer to section 5.2.9). But sometimes the books do not arrive on time or if they do arrive, there may be a shortage. These cases are beyond the control of the teacher or the school. There was a case in Limpopo province in 2012 where textbooks were not delivered by DBE, and some were found to have been thrown away by DBE officials while learners were waiting to get the textbooks (South African Press Association [SAPA], 2012). Furthermore, DBE requires that “no more than three learners may share space and equipment” (refer to section 4.2). But the question is, what should the teacher do? The teacher cannot always demonstrate because some skills that need to be tested include handling of apparatus and also measuring, and the learners cannot acquire these skills by simply observing the teacher during demonstrations. If the teacher has to put learners into smaller groups, there would be insufficient space for so many groups. These policy requirements become really problematic at times. Thus the meta-practices of politics and educational administration affects teaching practice (refer to section 2.2.4).

The problem of having too many learners in a class has the potential to create tensions between the teacher and the learners as was seen in ECT 05’s class, and the tension can result among the learners themselves as a result of competition for resources, furniture, space and even teacher’s attention. This eventually has a negative effect on the teaching and learning process. Ehrenberg et al. (2001) stipulated that big classes may cause “noise and disruptive behaviour, which in turn affect the kinds of activities the teacher is able to promote” (p. 1). They went on to say that class size “could affect how much time the teacher is able to focus on individual students and their specific needs rather than on the group as a whole” (Ehrenberg et al., 2001, p. 1).

7.2.9 Analytical statement 9: Teaching Biodiversity is a living practice

A practice is regarded as living if it has certain elements which Capra (2005) called principles of ecology when describing the relationships between entities making up an ecosystem. The idea of taking practices as living systems is explained by Kemmis et al. (2014) using the theory of ecologies of practices. The data presented and analysed in the previous chapter showed that teaching Biodiversity as a practice is part of an ecological system as it portrays the principles of living ecological systems. These principles were explained in section 2.2.2.1 and the evidence to this effect was provided in section 6.2. A case is made here that teaching Biodiversity, as a practice, is living, and it relates to other practices such as teacher training, teacher learning and assessment. In these discussions it is clear that these principles are not discrete entities but they overlap as one piece of evidence can be applicable to many of them.

7.2.9.1 Teaching Biodiversity networks with teacher training, teacher learning and assessment

During the Fundisa for Change Biodiversity training, teachers are trained in three main focus areas: content knowledge (as discussed in section 4.3.1.1.1), teaching methodologies (as section 4.3.1.1.2 shows) and assessment strategies (refer to section 4.3.1.1.3). TT 01-I (paragraph 30) explained how training is conducted: one session is “dealing with the enrichment content, the next dealing with the analysis of the textbooks and choosing how to teach it [content], and the next being how to assess.” This shows how the training links to teacher learning, teaching the content and assessing learning. The training is aligned to CAPS as DBE and SACE require. Bennet and Armstrong (2012, pp. 263-264) attested to the importance of this saying that “curricular integrity is achieved when teachers are knowledgeable about their subject matter, instructional strategies are in keeping with the intent of the discipline, and the assessment methods are intentionally selected to provide evidence of student learning”.

7.2.9.2 Teaching Biodiversity is nested within the practices of teacher training, teacher learning and assessment

Learner performance is at the centre of the education practices. All efforts are directed towards improving the performance of the learners and this comes in many ways. Teacher training is one such initiative which is important in providing teachers with subject content knowledge and skills on teaching and assessment methods. Huber (2011, p.837) indicated that across the world, there is “an agreement about the need for teachers and school leaders to have capacities required to improve in their schools the teaching of the teachers for the learning of the pupils”. The teacher prepares to teach the content already knowing the kind of assessment needed as elaborated in section 4.3.4.3. Kanjee (2009) emphasised that “the effective use of assessment by teachers can have a significant

impact on improving learning. However, teachers require adequate support and appropriate resources to enhance their classroom assessment practices.”

7.2.9.3 The practices of teaching Biodiversity, teacher training, teacher learning and assessment are interdependent

The evidence to this effect was presented in section 6.2.3. As mentioned in section 2.2.2.1.3, living practices are dependent on each other. Sections 4.3.3.5 and 4.3.4 elaborated on the participants’ learning during the training by gaining new knowledge, new teaching skills and new assessment methods. Resource materials based on content knowledge, teaching and assessment strategies were distributed to the participants for reference as section 4.3.4.4 shows.

One of the participants indicated that taking students out for a fieldwork was “much easier” as the training had exposed her to this method of teaching (MPT 01-I, paragraph 171). This shows how the training influenced the way this teacher conducted fieldwork. If she had not attended the training, she would not have been able to conduct the fieldwork effectively. MPT 02 also confirmed that she was not very knowledgeable about fieldwork, therefore attending the training was very helpful (paragraph 179). During the training, teachers were informed of the importance of briefing learners before going on a fieldtrip (ECT 05-I, paragraph 218) and developing fieldwork activities in the form of worksheets to keep the learners focused and hence achieve the goals of taking them out (TT 02-I). The changing of the curricular demands that teachers be trained on how to implement the curriculum (see section 2.3), meaning that the way teachers teach and assess will be influenced by how they are trained and how they learn during the training (see section 6.2.3). On the other hand, the planning and the running of the training is also dependent on the curricular demands in terms of the content, methods of teaching and assessment, and the context of the teachers (refer to section 6.2.3). Berthou and Buch describe the dependency between practices by saying that “As practices unfold and intersect, they tend to become the ‘environment’ for other practices” (2018, p. 31). The activities that teachers were given during the training, which included designing assessment tasks that address the different cognitive levels of the learners, were meant to improve teachers’ assessment practices. The different facilitating strategies used by the facilitators were also meant to influence change in the way teachers present Biodiversity lessons. These are signs of how teacher training, teacher learning, assessment and the teaching of Biodiversity are interdependent.

7.2.9.4 The practice of teaching Biodiversity is diverse

The diverse nature of teaching Biodiversity was presented in section 6.2.4. Teaching Biodiversity consists of minor practices such as lesson planning, lesson presentation, assessment for-and-of

learning, practical teaching and reflective teaching, to mention a few. These minor practices are important in that they work individually towards making the teaching of Biodiversity as a whole successful (refer to section 2.2.2.1.4). Planning a lesson helps the teacher prepare for how the lesson is to be conducted by showing a step-by-step process of how it unfolds. Reflective teaching on the other hand helps the practitioner to become better in the sense that a lesson is analysed for the purposes of improving it, if one has to present it again. Kemmis et al. (2014) indicated that a more diverse practice is capable of lasting longer as it can respond differently to unfavourable conditions. If the teacher has been exposed to several teaching strategies during the training, she or he will be able to use more than one of these in her or his teaching to cater for different learners' needs (refer to sections 4.3.1.1.2 and 4.3.1.2.1.2). Teacher training, teacher learning and assessment are also part of teaching Biodiversity practices as explained in sections 7.2.9.1, 7.2.9.2 and 7.2.9.3.

7.2.9.5 The practice of teaching Biodiversity flows through the ecosystem in cycles

The trained teachers become resource persons in their schools and clusters as they are able to pass the information on to others and are advised to do so during the trainings (refer to sections 6.2.5 and 6.2.6). They also have the potential to pass the information to the new teachers being employed at their schools. The trained teachers are able to work with new groups of students every year using the skills they have acquired. As long as these trained teachers are available, the information and skills gained can be tapped, and they can improve these skills further by attending more training or refresher courses. As the teachers pass the knowledge and the skills to others, practices cycle through the ecosystem and as they do so they are 'reproduced' in other practices and "generated by teachers as they take on facilitating in their own sites" (Edwards-Groves & Ronnerman, 2013, p. 133). Edwards-Groves and Ronnerman (2013, p. 134) further indicated that "practices, like energy, flow through other practices [and other people] related to it [them], in the complex of practices associated with facilitating teacher professional development".

7.2.9.6 The teaching of Biodiversity practice improved among the participating teachers

The teachers shared sentiments that the training improved not only their teaching and assessment skills but their subject content knowledge as well (4.3.4). This is in line with the general characteristics of effective teacher training programmes such as Fundisa for Change (refer to sections 2.4.2.2 and 4.3.3.5). The training also positively changed the attitudes and values of some of the teachers about the environment and taking students out on a fieldtrip as indicated in sections 4.3.4.5 and 6.2.7. The improvement in teaching and assessment strategies as well as subject content knowledge means these participating teachers are now further developed professionally and are able to do their work more efficiently. Edwards-Groves and Ronnerman (2013, p. 127) noted that "when

one practice in an ecology of practices becomes developed and strengthened ... the other parts of the complex of practices may also be developed and strengthened". They went on to say that "as part of an ecology of practices, development occurs when a practitioner's knowledge, skills and responsibility become more familiar with a practice and more expert or accomplished in it" (Edwards-Groves & Ronnerman, 2013, p. 132).

7.2.9.7 The sustainability of teaching Biodiversity practice

Teaching Biodiversity as a practice is able to unfold at a site through its connection with other practices such as teacher training, teacher learning and assessment. These other practices form part of the livelihood of this practice such that if there is a challenge with it, other practices are able to absorb the pressure to alleviate the challenge in an attempt to fulfil the purpose of teaching Biodiversity (refer to sections 2.2.2.1.8 and 6.2.8). Some teacher raised the challenges of lacking subject content knowledge in certain aspects of Biodiversity as well as in aligning teaching and assessment methods with the content to be taught but that did not mean that they could not teach the topic (refer to section 4.3.4). A teacher who did not have appropriate apparatus to run a practical did not simply sit and not teach the students; instead the training gave him knowledge and skills to improvise in cases where there is a shortage of apparatus or resources (refer to section 4.3.4.5). Teacher training and teacher learning enabled the smooth running of the lesson. One participant who had recently begun her teaching career indicated that she did not know how to prepare practical tasks for assessment (refer to section 4.3.4.3) and attributed the knowledge and skills she acquired to have overcome this challenge to Fundisa for Change training. This further demonstrates the positive role played by teacher training, teacher learning and assessment practices in enhancing the teaching of Biodiversity practice. This confirms the ecological relationship between these practices and that teachers can "transform their own learning into their own teaching" (Edward-Groves & Ronnerman, 2013, p. 125).

7.3 Summary of the study

Steyn (2011) has indicated that "teachers can play a key role in making a difference in the quality of education, since investing in teachers' development may have more positive effects than investing in other physical resources" (p. 43). This shows that professional development of teachers is very important as the masses of young people who are the future drivers of the country's economy are dependent on the teachers. The knowledge is changing, triggering changes in many policies of the country, the curriculum being an example. This means that the citizens of the country need to keep up with changing knowledge, especially in Environmental Education where there is an intense debate about the environment and how humans impact on it (O'Donoghue, 2014, p. 10). Steyn and

Van Niekerk (2005) indicated that a professional development initiative, such as Fundisa for Change continuing teacher professional development programme, “helps teachers acquire the most up-to-date knowledge of the subjects they teach and to use techniques that are powerful in enhancing student learning” (p. 130). Steyn and van Niekerk (2005) further made the point that:

No pre-service training programme can effectively prepare people for a life-time in organisations. Moreover, the skills and knowledge of educators can decline over time. As such a need exists for educators to be regularly, if not continually, involved in quality programmes of development for the sake of improving learner performance. (p. 144)

It is therefore imperative that teachers are involved in professional development initiatives to keep up-to-date with developments in their field and to improve their teaching practice. However, not every continuing teacher professional development initiative is effective (Steyn & van Niekerk, 2005). Effective continuing teacher professional development programmes such as the Fundisa for Change programme are characterised by: actively involving teachers in training activities; being run over a longer period of time; promoting collaboration among teachers; being coherent; following up on trained teachers; and in the South African context, involving assessment of teachers.

This study addressed the following main questions, the answers to which were provided as analytical statements:

1. What are the teachers’ experiences of the Fundisa for Change continuing teacher professional development programme in relation to environment and sustainability content knowledge?

The answers to this question are provided by analytical statements 1 to 4. The Fundisa for Change programme improved the participating teachers’ Biodiversity content knowledge, teaching and assessment skills. It also positively influenced teachers’ attitudes and values towards teaching Biodiversity.

2. How does the Fundisa for Change continuing teacher professional development programme influence teachers’ practice?

The answers to this question are provided by analytical statements 1 to 3, and 6 to 8. Improved Biodiversity content knowledge and improved teaching and assessment skills eventually lead to improved teaching practice, which in turn will improve learner

performance. The teachers realised the importance of always linking the teaching and assessment methods to the subject content to be taught. The Fundisa for Change programme encouraged teachers to improvise and use the local environment in their teaching to try to tackle the problem of lack of funds and equipment. Teachers have found this to be very useful.

Even though the Fundisa for Change programme equips teachers with skills to implement the Biodiversity section of the curriculum, there are certain conditions which affect the way the teacher teaches and assesses this content. These conditions include the use of language (both scientific and instructional); infrastructure (availability or absence of: computer laboratories, science laboratories, extra classrooms and libraries), teaching and learning support materials, including laboratory apparatus, and class size; and the policies.

3. What practices of the Fundisa for Change teacher professional development programme are characteristic of effective continuing teacher professional development initiatives?

The answers to this question are provided by analytical statement 5. These characteristics are:

- Duration (teachers are trained over a longer period of time)
- Active involvement of teachers
- Providing teachers with subject content knowledge
- Promoting establishment of professional learning communities
- Coherence (training is in line with teachers' needs and policy requirements)
- Follow-up
- Assessment of teachers

4. How are (if at all) the practices of teacher training, teacher learning, teaching and assessment of Biodiversity content in CAPS living practices?

This question was answered by the analytical statement 9 which showed, through the characteristics of living systems or what are called the principles of ecological systems, that these practices are indeed living. The characteristics or principles portrayed by these practices, teaching Biodiversity being the main focus, are:

- Networking
- Nested nature

- Interdependency
- Diversity
- Flows
- Cycles
- Development
- Sustainability (dynamic balance)

These principles have also been able to indicate how these practices relate to each other and how they are sustained in the ecological system.

7.4 Contribution to knowledge

This study has focused on two aspects: the teaching of Biodiversity as a practice and continuing teacher professional development. This study has been able to show that the teaching of Biodiversity can be looked at in terms of practice architectures' and ecologies of practices' theoretical lenses. Although studies have been carried out that used practice architectures and ecologies of practices, no study was found that specifically discusses teaching Biodiversity as a practice, especially in the South African context. The uniqueness of this study is realised in describing teaching Biodiversity in terms of the sayings, doings and relating; and further looking into its practice architectures, which are the conditions that enable, constrain and sustain this particular practice (refer to sections 2.2.1 and 5.2).

Furthermore, teaching Biodiversity as the main focus practice in this study, relates to other practices whose main aim is to improve learner performance. As Edwards-Groves and Ronnerman (2013, p. 137) confirmed, "interdependent ecological relationships exist between different practices". The closely related practices to teaching Biodiversity which were discussed in this study are teacher training, teacher learning and assessment (refer to sections 6.2.1, 6.2.2 and 6.2.3). These practices were also looked at to describe their relationality and hence their living nature as discussed in section 6.2. The theory of ecologies of practices describes the relationships between the practices as it is the case with living organisms in such processes as food chains and food webs. It is, however, important here to mention that the relationship in this case is two-way showing interdependence unlike in food chains and food webs which are one-way relationships in which the predator depends on the prey for food. The human element is also involved in this relationship..

Looking at the principles or elements of ecologies of practices under discussion in this study, it is possible to re-organise these elements to describe the implicit and explicit relation between the

practices. There is a direct relationship between the following principles: network, nestedness and interdependency as exemplified in sections 6.2.1, 6.2.2 and 6.2.3 respectively. However, other principles, which are: diversity (in section 6.2.4), cyclical nature (in section 6.2.5), flow of matter (in section 6.2.6), development (section in 6.2.7) and dynamic balance (in section 6.2.8) show an implicit relationship as shown by red dotted lines in Figure 7.1 below. This figure can be used to also explore the relational aspect of practices as living entities. Essentially, the figure shows that all the elements on the figure demonstrate relationality between practices thereby affirming their living nature.

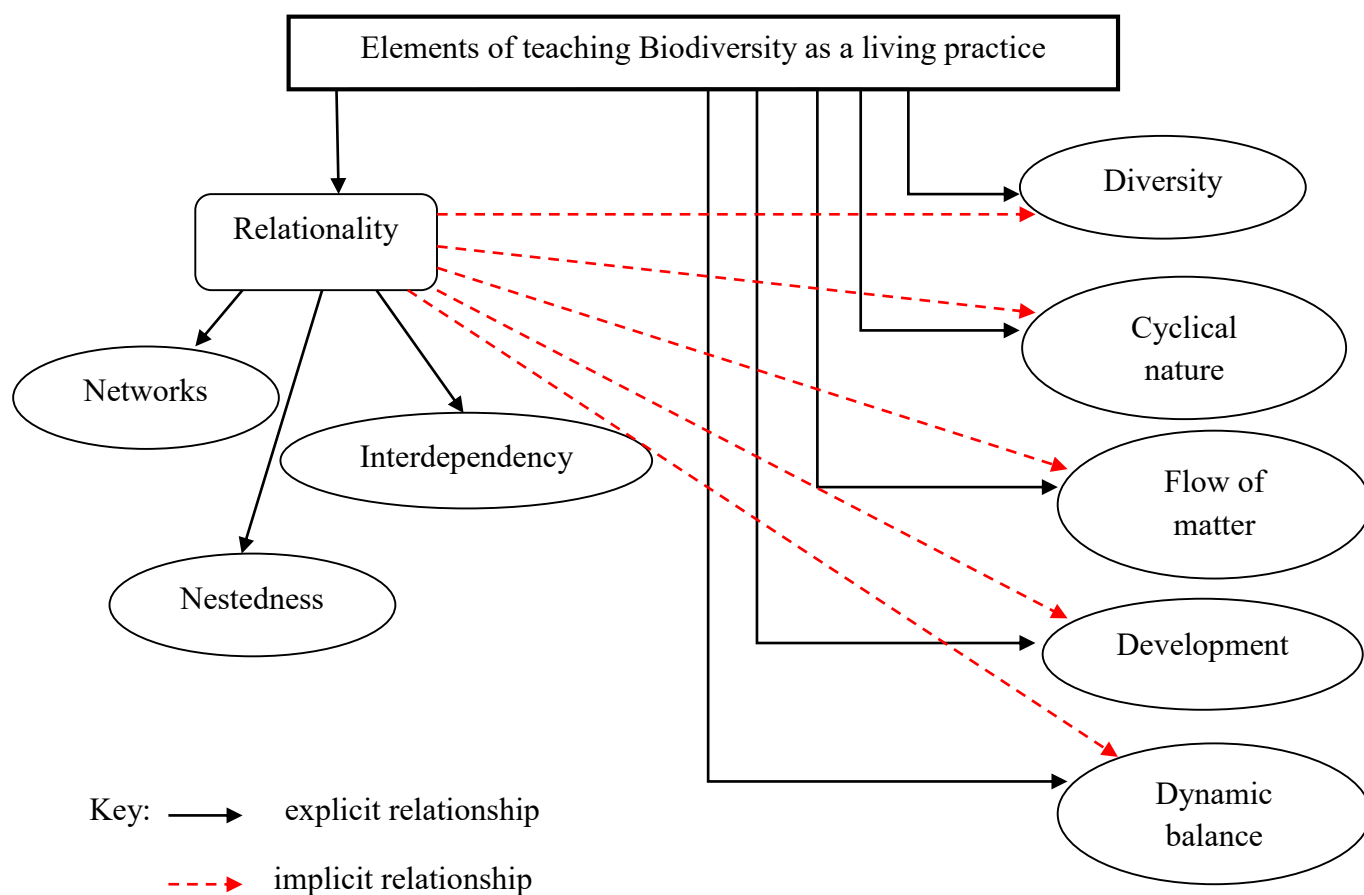


Figure 7.1: Implicit and explicit relationality between teaching Biodiversity and its associated practices

Teaching Biodiversity and its related practices are part of the meta-practices in the broad spectrum of the education complex (Kemmis & Heikkinen, 2011; Kemmis et al., 2014) as explained in section 2.2.1. Teaching Biodiversity and assessment practices are nested within the meta-practice of teaching; and teacher training and teacher learning practices form part of the meta-practice of initial

and continuing teacher education. All the efforts made in keeping these practices alive and sustaining them centre around student learning. As Huber (2011, p. 37) emphasised,

... teachers and school leaders need to have a profound knowledge of learning. They need this knowledge in order to take care of their own learning as professionals and that of their colleagues, staff and that of their pupils. In their professional responsibility, they are in charge of providing learning opportunities and of creating a supportive learning environment for all stakeholders.

The most important element that emerged from the discussions on the effectiveness of continuing teacher professional development initiatives in the context of South Africa as per SACE requirements is assessment. This aspect is not very important from an international perspective as it was infrequently mentioned in the literature (refer to section 2.4.2.6). In South Africa, however, the requirement by SACE for accrediting courses is that there should be a form of assessment to demonstrate competence by the participants. One of the SACE endorsement criteria for SACE approved courses is that the course is regarded as effective if “assessment tasks are designed to enable teachers to demonstrate achievement of the outcomes and the overall purpose”. An application is submitted to SACE every year for Fundisa for Change programme course accreditation, whether it is a short course with 15 credit points or a long course with 20 credit points. In South Africa, it is mandatory for teachers to engage themselves in development activities for them to acquire at least 150 credit points over a three-year cycle (SACE, 2013, p. 11). Teachers cannot therefore acquire these points if they had not participated in accredited continuing teacher development activities.

7.5 Recommendations

7.5.1 Recommendations based on the findings

The fact that the participating teachers lacked knowledge on some of the concepts means that there are many others out there who did not have the opportunity to attend continuing teacher professional development trainings such as the one offered by Fundisa for Change teacher training programme. Efforts should be made to offer these training programmes to as many teachers as possible – ideally to all teachers, as SACE demands that “all state-employed teachers and many privately-employed teachers are required to undertake professional development as part of their conditions of service” (2013, p. 7). The teachers who attended the training wanted more sessions, but the question would now be what about those who did not attend? How would they feel if the ones who attended wanted more? It has been evident that if a teacher is not confident about the subject content, it is difficult for that particular teacher to even think of appropriate teaching and assessment strategies as they

are linked to the content (refer to sections 4.3.1.2.1 and 7.2.3). This negatively affects the teacher's practice which eventually leads to poor learner performance. This calls for a more structured plan of action from DBE as the main stakeholder on how to assist organisations and institutions involved in training teachers, and more involvement by other stakeholders in education such as institutions of higher education.

The inadequate supply of teaching and learning support material and furniture at the schools is a great challenge. This also impacts negatively on teaching practice and may even prevent teachers from implementing the ideas and skills acquired from the training. Communication between school management and DBE officials has to be effective in order to address these issues because eventually it is the learners who are severely affected if the situation does not improve. The same applies with inadequate infrastructure and a large number of learners in a classroom. These conditions also ruin the relationships among learners themselves as they fight over the minimal resources (for example, when they share textbooks), and between learners and teachers. The Norms and Standards for Education in South Africa state that the number of learners in a classroom should not be higher than 30 in Grade R, and not more than 40 in other grades (South Africa. DBE, 2013, p. 14). Schools are also compelled to have school libraries or media centres and equipped school laboratories for science, technology and Life Sciences subjects (South Africa. DBE, 2013, p. 17). As observed in this study, there was as many as 62 learners in a Life Sciences classroom at one particular school (see section 5.2.9).

The issue of following up on the trained teachers to see what challenges they are facing at their schools is not clearly spelt out in the Fundisa for Change training programme, even though the trainers indicated portfolio assessment as one way of doing this. If this is clearly described as one of the activities of Fundisa for Change, then it might be done in a more structured way. Sometimes the follow-up is thought to be part of professional learning communities activities once established. The Fundisa for Change programme encourages teachers to establish these communities, and it does not have a clear mandate to help teachers establish and sustain them. The main role player in this regard is DBE, and these communities or groups seem to be growing very slowly. There is a pertinent need for establishing these communities of practices not only across different schools or educational districts but even within the schools. A vivid example here came from MPT 01 and ECT 06 who were newly-qualified teachers talking about their experiences at school and getting little or no support at all, yet MPT 01, on her first day, had to teach Grade 12, while ECT 06 had to give Grade 10 learners a practical as required by CAPS but she did not know how to set this (refer to sections 4.3.3.6 and 4.3.4.3). It is suggested that the Fundisa for Change trainings be offered to

teachers in the same cluster as it would be easy for them to meet as they have regular meetings to moderate their work. It would also be easy to conduct follow-up sessions with the trained teachers who are in close proximity to one another and they might also have common challenges. As Tshiningayamwe (2016) strongly recommended, the Fundisa for Change programme needs to offer continuous support to the trained teachers by strengthening the established PLCs due to the changing nature of environmental content knowledge as this has the potential to improve the teaching practices.

The plight of MPT 01 and ECT 01 as new teachers facing challenges in their first year of teaching needs to be highlighted. There is much research that brings to attention the importance of induction of newly qualified teachers. DBE needs to put into place measures to formulate a policy on the induction of newly qualified teachers as this does not exist currently. This will help many other new teachers that are facing similar challenges. Mashau, Mutshaeni and Kone (2016) noted that induction is one of the most important elements of teacher education, but it is not offered to newly qualified teachers in South Africa even though “the first year is a difficult year to overcome problems for novice teachers. A new teacher faces the challenge of understanding and fitting into the culture of his or her new school. So, it is needed to support them.”

7.5.2 Recommendations for further research

This research could be improved by actually going into the classrooms to observe teachers presenting these lessons. It is believed that more information could be obtained from the lesson observations to supplement data from the interviews, workshop evaluation forms, teacher portfolios and Fundisa for Change programme materials. It is also strongly recommend that teachers should be orientated about the importance of allowing researchers into their classrooms (refer to section 2.5), as there was an element of reluctance among some teachers to be observed. Lesson observations could have been carried out in this study but this was impossible due to the fact that some teachers decided to withdraw from the study at the last minute. The use of teacher professional development initiatives such as a Lesson Study can be helpful to teachers in trying to acquaint them with the lesson observation practice and therefore change their mindsets about this (refer to section 2.4.1). This initiative is gaining momentum in South Africa as universities such as University of Pretoria and University of Free State are partnering with DBE and Japan International Cooperation Agency to implement this (Masenamela, 2018).

There was a one-year gap between the time the teachers were trained and the time they were interviewed. This seemed to have been a long time, to such an extent that some of the teachers had

forgotten about what happened during the lessons. It was helpful in this regard to have been given back their portfolios to remind them which enabled a form of stimulated recall and reflection. It would be better if studies like this are carried out immediately after teacher training when teachers still have high levels of motivation to implement the skills and ideas.

For some people, the scope of this research in terms of the sample, which consisted of seven teacher trainers and nine teachers, might seem small. There is the possibility of including more participants for more data and to improve representation. The idea of ecologies of practices (Kemmis & Heikkinen, 2011 and Kemmis et al., 2014), which is about practices being ‘living things’ and depending on each other for survival, and having been adapted to the areas where they ‘live’, can be extended to look closely at the contextual factors affecting their livelihood. This was evident in lessons conducted by MPT 03 (Water-holding capacity of the soil) and MPT 04 (Water retention property of the soil). This lesson is about the same soil property, but this property is named differently (language use), even the apparatus being used (real apparatus on one side and plastic bottles on the other side) (resources), and the teachers and learners (relationships) involved are different. This idea could be a research study on its own, that investigates how the context shapes the practice, resulting in it adapting to its environment or habitat, the same way a living organism will do. The teaching Biodiversity practice architectures discussed in section 5.2.9 can also be investigated further to find out how they impact on student learning or performance. This research study was more focused on teaching Biodiversity as a practice but the same amount of effort could be directed to each of the practices which are associated with teaching Biodiversity such as teacher training, teacher learning and assessment. These could involve separate research studies.

Research can also be carried out on the Fundisa for Change training programme itself, to look at the sayings, doings and relatings in the training programme with regard to its different practices, such as training of teachers and material development, and the conditions (practice architectures) which enable or constrain such practices. There is also room for research on the induction of newly qualified teachers to inform policy formulation on this aspect. Further research can be carried out to follow up on the trained teachers as there have been calls for refresher training.

7.6 Conclusions

This chapter has discussed the results presented in Chapter 4 which gives teachers’ experiences on the Fundisa for Change teaching Biodiversity training they attended, and the Fundisa for Change programme characteristics; Chapter 5 which is about the conditions that enable and constrain the teaching of Biodiversity practice; and Chapter 6 which looked at the living nature of teaching

Biodiversity, by using analytical statements. The arguments were substantiated by the literature presented in Chapter 2 and relevant ideas from other authors. The significance of this study is the fact that it provides an insight into how teachers experienced the training and whether the Fundisa for Change programme meets the demands of continuing teacher professional development initiatives that are regarded as being effective. This research also provides a new way of looking into continuing teacher professional development in the South African context within the Biodiversity sector. The theory of practice architectures is about not only understanding teaching Biodiversity as the activity, but as doings (actions, distribution of materials, funds, space and time), sayings (ideas, thinking and language), and relatings (relationships among the humans and between humans and non-humans), and the conditions (the arrangements) under which the practice is shaped as it unfolds. These conditions are summarised in section 5.2.9. The ecologies of practices as a theory looked at how teaching Biodiversity relates to teacher training, teacher learning and assessment. I did not find any literature on the use of this theory in continuing teacher professional development in Environmental Education in South Africa, though it has been used internationally, (Kemmis & Mutton, 2012). It has also been used in looking at induction practices of newly qualified teachers (Kemmis & Heikkinen, 2011).

Lipowski, Jorde, Prenzel, and Seidel (2011, p. 687) indicated that professional development of teachers, in science education, can focus on several aspects, one of which is the teachers themselves. This study also partly focused on this aspect. Lipowski et al. (p. 689, 2011) further highlighted two important elements of effective continuing teacher training initiatives internationally: professional learning communities which provide space for teachers to work together as in most cases classrooms are structured such that teachers work in isolation; and longer training duration to give teachers enough time to reflect on their practice for improvement. These are some of the elements that characterise the Fundisa for Change programme. Teacher professional development initiatives are important in implementing Environmental Education as teachers need to be trained on environment and sustainability content knowledge and teaching methods (UNESCO, 2014, p. 31).

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APPENDICES

Appendix A: Fundisa for Change Network Partners



Source: Zintle Songqwaru, Fundisa for Change Presentation, 5 April 2013

Appendix B: Teacher interview schedule

Date:

Time:

Part A: School profile

1. What is the name of your school? (Optional)
2. When was the school established?
3. Where is the school located?
Province: City:Town:
Educational District:
4. Is the school public or private?
5. Do learners pay school fees?
6. What is the total learner enrolment at your school?
7. What is the average number of learners per class at your school?
8. What language of instruction is used at your school?
9. What home-language do most learners speak at your school?
10. What resources are available at the school to facilitate the process of teaching and learning?

Part B: Class profile (The class in which the lesson was presented)

1. Grade:.....
2. What was the total number of learners in this class?
3. How were the learners seated?
4. Did all learners have chairs and desks?
5. Was there proper ventilation in the classroom?
6. What resources are/were available (in the class) to facilitate the process of teaching and learning Biodiversity?

Part C: Participant profile

1. Your name (optional):.....
2. Gender:.....
3. What are your professional qualifications?
4. Why did you study to become a teacher, and in particular, a Biology/Life Sciences/Science teacher?
5. For how long have you been teaching Life Sciences?
6. What Grades do you teach?
7. What other subjects do you teach?
8. What is your home-language?

Part D: Interview questions

- **Questions on the Fundisa for Change teacher training**

1. Why did you decide to attend Fundisa for Change teacher training?
2. What were your expectations of that training?
3. Had your expectations of this training been addressed? If yes, please explain.
4. Did you attend any Curriculum and Assessment Policy Statement (CAPS) training prior to attending the Fundisa for Change training workshop?
If yes, what did you learn in that training?
5. Was the Fundisa for Change teacher-training different from the CAPS training you attended, if any? If yes, how was it different? (Time, duration, content, location, delivery, etc).
6. What challenges, if any, did you experience in implementing CAPS at your school before attending the Fundisa for Change teacher-training workshop, and in particular, in teaching Biodiversity? (Content, support, etc). How, if at all, do you think the Fundisa for Change teacher-training addressed those challenges?
7. What kind of support, if any, do you get in implementing CAPS and in particular teaching Biodiversity? Where do you get this support from?
8. How do you compare Fundisa for Change support to other forms of support you were exposed to?
9. How would you rate your knowledge before and after Fundisa for Change training in terms of the following concepts?

Adapted from Fundisa for Change Course Evaluation (2013)

	Strong, completely adequate	Not bad, but needs improvement	Weak, needs strengthening
Ecosystems	Before <input type="checkbox"/> After <input type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>
Please comment on your rating:			
Biodiversity	Before <input type="checkbox"/> After <input type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>
Please comment on your rating:			
Taxonomy	Before <input type="checkbox"/> After <input type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>
Please comment on your rating:			
Human-environment	Before <input type="checkbox"/> After <input type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>	Before <input type="checkbox"/> After <input type="checkbox"/>
Please comment on your rating:			

- What concepts, if any, did you struggle with when teaching Biodiversity before attending the Fundisa for Change training workshop? Did the Fundisa for Change teacher-training help you in any way?
10. What new environment and sustainability content knowledge (on Biodiversity), if any, did you gain from this workshop?
 11. What teaching method(s) do you use in teaching Biodiversity?
Why do you use that (those) particular teaching method(s)?
 12. What new teaching method(s), if any, did you learn in this training?
Have you used that (those) particular teaching method(s)? Please motivate your answer.
 13. What assessment strategies do you use to assess your learners?
Why do you use those particular assessment strategies, and for what purpose?
 14. What new assessment strategy (strategies), if any, did you learn in this training?
Have you used that (those) particular assessment strategy (strategies)? For what purpose have you used them?
 15. What teaching and learning support materials (TLSM) do you use in teaching Biodiversity?
Why do you use those particular TLSM?
 16. How, if so, has this training influenced you in the use of TLSM in teaching Biodiversity?
What new TLSM have you learnt about in this training to teach Biodiversity?
 17. What experiences, if any, of Fundisa for Change continuing teacher professional development programme are or have been significant to you? What did you like most about the training programme? Which areas of the training do you think need improvement?
 18. What do you think a continuing teacher professional development programme such as Fundisa for Change should entail, to be effective?
 19. How has this training impacted on your teaching practice generally?
(How do you think this training workshop has, if at all, impacted on your sense of well-being and professional development?)
 20. Is there any other idea you will like to highlight about the training which was not covered by the questions?
- **Questions on the Biodiversity lesson presented**
 1. What part of the Biodiversity Unit was this lesson? Was it the first, the middle or the last part of the unit?
 2. What were the objectives of the lesson?
 3. Were the objectives of this lesson achieved? If so, how?

4. What went well in the lesson?
(How were the learners engaged in the lesson? What were you doing? [Please refer to photos])
5. How did you prepare for this lesson?
6. Where did you draw your knowledge of the content to be taught from?
7. What challenges did you encounter in teaching this topic in this class?
How did you deal with those challenges?
8. How, if at all, had Fundisa for Change teacher training programme influenced you in preparing and teaching this lesson?
9. Which teaching method(s) did you use in this lesson, and why?
10. What assessment strategies did you use to assess your learners in this Biodiversity lesson?
Why did you use those particular assessment strategies, and for what purpose?
11. What teaching and learning support materials (TLSM) have you used in teaching this Biodiversity topic in this class? Why did you choose to use those particular TLSM?
12. If you were to teach this lesson in another class, what would you do differently?
13. Is there any other idea you will like to highlight about the way the lesson went which was not covered by the questions?

Thank you very much for your time.

Appendix C: Teacher trainer interview schedule

Date:Time:

Part A: Organisation/institution profile

1. What is the name of your organisation/institution?
2. When was the organisation/institution established?
3. Where is the organisation/institution located?

Province:City:Town:

4. For how long has the organisation/institution been involved in training teachers?

Part B: Participant profile

1. Your name (optional):
2. What are your professional qualifications?
3. For how long have you been training teachers on Environmental Education, and in particular, Biodiversity?
4. What is your home-language?

Part C: Interview questions

1. What motivated you to be involved in conducting this training workshop?
2. What kind of support was offered to the teachers in this training workshop in terms of subject content knowledge, teaching methods and assessment strategies? Why this kind of support?
3. What challenges, if any, do you think teachers are experiencing in implementing CAPS, and in particular, in teaching Biodiversity?
How, if at all, do you think this training addressed these challenges?
4. What do you think are the important conditions for a successful teacher training programme, and why? Which of these conditions characterise Fundisa for Change teacher training programme?
5. How do you think this training programme had, if at all, impacted on teachers' classroom practice?
6. How do you think this training workshop had, if at all, impacted on the teachers' sense of well-being and professional development?
7. What activities for the teachers were included in the training program? In these activities, which topics were central, and why?
8. Is there any other idea you will like to highlight about the training which was not covered by the questions?

Thank you very much for your time.

Appendix D: Interview transcript

Interviewer: **R** (Researcher)

Participant: **MPT 05**

Date: 28-05-2014

Time: 09h30

Duration: 00:38:11 (Actual: 36min)

R: When was the school established?

MPT 05: Meaning this school?

R: Yah. This school.

MP 05I: It was established in the 1980s.

R: Okay, in the 1980s.

MPT 05: Mm.

R: Okay. And then the ... well the province is ... it is located in Mpumalanga, and then the city?

MPT 05: Mbombela.

R: It's Mbombela, and then this town where it is found?

MPT 05: Nelspruit.

R: Nelspruit, okay. And in Nelspruit, don't you have like smaller town, I don't know, I've seen KaBokweni ...

MPT 05: KaNyamazani ...

R: Yah, yah. Okay. So this one is in ...

MPT 05: KaBokweni.

R: KaBokweni. Okay. And then the educational district?

MPT 05: It's Ehlanzeni.

R: Ehlanzeni, okay. Is this a public or a private school?

MPT 05: Yah, it's a public school.

R: Okay. Do learners pay school fees?

MPT 05: Yah. They pay school fees.

R: Okay. Roughly what's the fee?

MPT 05: It's R100.

R: It's R100.

MPT 05: [Interrupting] No.

R: ... per year?

MPT 05: Per year.

R: Okay. Okay. Then is it something that the ... do you know whether it is something that the parents agreed upon or was it originally classified as a non-fee paying school and the parents decided that okay it's fine even if we can contribute R100?

MPT 05: Yah, according to my understanding it's something that they agreed upon.

R: Okay.

MPT 05: Yah.

R: Okay. Alright. And then what is the total learner enrolment, total learners at school?

MPT 05: Mmm, it's 1200.

R: Okay.

MPT 05: 1200. Roughly 1200 ...

R: Okay.

MPT 05: ... plus or minus.

R: Okay.

MPT 05: Yah.

R: And then the average number of learners in class?

MPT 05: In class, we've got 45.

R: 45.

MPT 05: Yah.

R: Okay. And what language of instruction is used at school?

MPT 05: It's English.

R: It's English, okay. The Home Language?

MPT 05: SiSwati.

R: The learners?

MPT 05: They are using SiSwati mostly.

R: Most of them speak Swati, okay. And then what are the resources that available for ... or to facilitate the process of teaching and learning? And maybe here you can also think of the lesson that you presented, what resources do you have? Like in general, at school, and also in particular to the lesson that you ... you were teaching.

MPT 05: Yah. I used my textbooks as the resource ...

R: Mm.

MPT 05: ... and also my study guides. I also used my presentations in power-point ...

R: Okay.

MPT 05: ... using projectors.

R: Okay.

MPT 05: Yah.

R: So in classes do you have fixed projectors or ...

MPT 05: [Interrupting] No, we've got ... we've got a screen chart that you can project on to it ...

R: [Interrupting] Okay, okay. So are most teachers able to access that?

MPT 05: [Thinking]

R: It means they will need to have laptops ...

MPT 05: Yah.

R: ... to move around.

MPT 05: Yes. We have laptops. We also have school laptops.

R: Okay.

MPT 05: But we prefer using ours because when at home we prepare our lessons ...

R: Okay.

MPT 05: ... in our computers.

R: Okay, and how many of those mobile projectors and screens do you have? Say in case you are using it and the other teacher wants to use that equipment, is there like ... do you have another set?

MPT 05: Yah. We've got ... each department has got a projector, Commercial Sciences, etc.

R: Mm.

MPT 05: Yah.

R: Okay. So in terms of the science laboratories?

MPT 05: We have ... we were donated with a mobile lab.

R: Okay.

MPT 05: Yah, of which we used to take to class which has all the facilities ...

R: Okay.

MPT 05: ... in it.

R: So the school, is it a Dinaledi school? Do you know Dinaledi schools? The Maths and Science focus schools.

MPT 05: No. No.

R: Okay. So what is the focus of this one?

MPT 05: Yes we've got Maths and Science. We do have a person who assists in terms of Maths and Science at the school.

R: Okay. And then the library? Have you got a library?

MPT 05: Yah. We've just fixed the library. We completed one classroom to make it a library.

R: Okay.

MPT 05: They are putting some books in there.

R: Okay. Okay. Alright. Computer lab?

MPT 05: Yah, computer lab, we do have it.

R: Okay. How many computer labs?

MPT 05: We have only one computer lab.

R: One, and is it like functioning?

MPT 05: Yah, it's functioning. It's functioning.

R: Okay. Okay. Alright. And then coming to the class in which the lesson was presented, what Grade was it?

MPT 05: Grade 10.

R: It was Grade 10, okay, and what ... what was the total number of learners in the class? Did you say 45?

MPT 05: Yah those ones were even two classes, of Grade 10.

R: Okay. Okay.

MPT 05: The first one was 28, last year.

R: Mm. Last year.

MPT 05: Then the other one was 36, if I'm not mistaken.

R: Okay. Alright. And how were the learners seated? Were they seated in rows or in groups?

MPT 05: No they sit in rows.

R: In rows, okay. And any reason to sit in rows, or in groups? But you said in rows this time.

MPT 05: Yah they sit in ... I'll say in rows because it is the arrangement of our class. We are using the double-bunk desk when sit in twos.

R: Okay. Okay. So the numbers seem to be small, 28 and thirty ...

MPT 05: 36, yah. Last year Grade 10 was small.

R: Okay. So do they choose to ... do learners choose to do Life Sciences or is it done by all Grade 10s?

MPT 05: No they choose. At Grade 10 that's where they start splitting.

R: They start streaming.

MPT 05: Mm.

R: So you had fewer learners that were interested in Life Sciences, so to say.

MPT 05: Yah.

R: Okay. And then were the chairs and desks enough for the learners, in that particular class?

MPT 05: Yah.

R: Okay. So there wasn't any learner standing ...

MPT 05: [Interrupting] No.

R: ... or maybe two sharing a desk. But you're saying they use a double-bunk.

MPT 05: [Interrupting] A double-bunk, yah.

R: Okay, so two learners per ... per that table.

MPT 05: Mm, per desk.

R: Okay. And then in terms of ventilation, was the class well ventilated?

MPT 05: Yah. The class was well ventilated.

R: Okay. Okay. And I think in terms of the resources you've mentioned them ...

MPT 05: Yah.

R: ... unless if there ... there are any you didn't speak of, for that particular class.

MPT 05: Yah. For that particular class I was using the very same resources, textbooks and guides.

R: The internet?

MPT 05: Internet, to search for information.

R: Okay. Alright. Maybe coming to your profile sir ... Er ... what are your professional qualifications?

MPT 05: Er I have Environmental Sciences, BSc in Environmental Sciences.

R: Okay. Okay. And then so Environmental Science, were you majoring in ...

MPT 05: I majored in Biology, Conservation Biology, Geography, as well as Ecological Resource Management.

R: Okay. So why did you take the Biological component of the Environmental Sciences?

MPT 05: Hey, I ... I like nature ...

R: Mm.

MPT 05: I like dealing with nature ...

R: Okay.

MPT 05: ... so that's why I've chosen the stream which is basically focusing on ... on what I like.

R: Okay.

MPT 05: Yah.

R: So will I say is that the reason why it landed you into teaching Biology?

MPT 05: Yah. I liked it since at school, while I was still at school. I liked it.

R: Okay.

MPT 05: Yah.

R: So maybe one ... reason why you liked it, Biology?

MPT 05: [Pause/Silence]

R: You talked about nature, neh?

MPT 05: Yah.

R: What is it that you really love about nature?

MPT 05: Nature ... in fact ... how can I put this? I love nature ... I love ... I love ... Er ... you know ... mutual life in fact.

R: Okay.

MPT 05: Mutual life.

R: Okay. It's something that you associate with.

MPT 05: And I associate with.

R: Okay. Alight.

MPT 05: Mm. Since I was young really ...

R: Okay. So how long have you been teaching Life Sciences?

MPT 05: It's five years now.

R: It's five years. Okay. And what Grades do you teach now, or even last year?

MPT 05: Now I'm teaching Grade 12 Life Sciences.

R: Mm.

MPT 05: Er ... last year I was teaching Grades 10 and 12.

R: Okay. So this year it's only Grade 12.

MPT 05: This year it's only Grade 12.

R: Okay. Are there any other subjects that you teach other than Life Sciences?

MPT 05: Yah. I'm also teaching Maths Literacy.

R: Mm.

MPT 05: Yah. Grade 10 and 11.

R: Okay. Last year?

MPT 05: Even last year, I was teaching Maths Literacy in Grade 10 and 11.

R: And how do you find teaching two subjects in different Grades? Is it not too much in terms of preparation?

MPT 05: Yah. It's too much.

R: Mm.

MPT 05: Yah, it's strenuous, but you need to get used to it ...

R: Okay. And then can you share with me what your Home Language is?

MPT 05: My Home Language is SiSwati.

R: SiSwati, okay. And how do you find teaching learners who speak the same language as you speak in class?

MPT 05: I find it ... it cool ... it's right because I'm able to ... to see whether they do understand or not.

R: Mm.

MPT 05: And then I tend to ... to explain even in vernacular ...

R: Mm.

MPT 05: ... to ... to ... to enhance their understanding.

R: Okay. Okay.

MPT 05: Mm.

R: Because there's this issue of code switching, that you are raising ...

MPT 05: Mm.

R: ... that you know our learners sometimes are ... English Language is their second language ...

MPT 05: Yah.

R: ... some of the concepts are difficult ...

MPT 05: [Interrupting] They are difficult.

R: ... so you can talk of a particular plant species outside , they know it in their Home Language ...

MPT 05: [Interrupting] They know it.

R: ... but the moment you call it in scientific name, they wouldn't know what it is.

MPT 05: [Interrupting] They wouldn't know. Yah.

R: So, yah, that's what the researchers are emphasizing at this point in time. Okay. Coming into the Fundisa for Change training itself, how did you know about the training?

MPT 05: Er ... they ... they ... in fact they ... they came ... there is this coordinator for Fundisa for Change, who came to school, looking for teachers for Grade 10 educators ...

R: mm.

MPT 05: ... and then she ... she then ... told us about the ...

R: The training.

MPT 05: ... the training ...

R: Okay.

MPT 05: ... and asked if we were interested in going.

R: Okay.

MPT 05: And we started attending.

R: Okay, and why did you decide to attend, now that you had information about the training? Are there any reasons?

MPT 05: I wanted to be fully capacitated in terms of organizing the scope, as far as Life Sciences is concerned.

R: Okay. So now what were you expecting out of the training?

MPT 05: I was expecting to ... Er ... in fact gain more ...

R: Mm.

MPT 05: ... gaining more, learning more things.

R: Okay.

MPT 05: Mm.

R: Okay. And then Er ... do you think your expectations were met by the training itself?

MPT 05: Yah.

R: Okay.

MPT 05: They were met. A goal I wanted ...

R: Mm.

MPT 05: ... if I may ... if I may mention ...

R: Mm.

MPT 05: ... we were taught about different ways of introducing a topic.

R: Mm.

MPT 05: Trying to ... making sure that the learners are ... get the insight of what you want to ... to teach them about ...

R: Mm.

MPT 05: ... as well as being capacitated.

R: Ok. In terms of ... knowledge?

MPT 05: In terms of knowledge ...

R: Okay.

MPT 05: ... skill.

R: Okay. And then the assessment strategies?

MPT 05: Yah, as well as assessment strategies. We were told about using these worksheets.

R: Mm.

MPT 05: Yah, giving them the class-work ... you have to give class-works and home-works.

R: Okay. And then tell me did you attend any CAPS training, maybe before Fundisa for Change training or even after Fundisa for Change training?

MPT 05: Yah I did attend it.

R: Okay. Who or which organization was running the CAPS, that CAPS training?

MPT 05: The Department of Education.

R: Okay. And then what did you learn ... what did you learn there?

MPT 05: Er ... it was the switching, the switching ... switching from the old curriculum to the new curriculum, CAPS.

R: Okay.

MPT 05: Mm.

R: So then ... Er ... how is the Fundisa for Change workshop or training now different from the one training that you are talking about, the one that was organised by the Department?

MPT 05: No. The ... the only difference is that the one for the Department, it was ... Er ... they were teaching us or telling us or facilitating on things that we know ...

R: Okay.

MPT 05: ... okay, as educators.

R: Mm.

MPT 05: Just to say now Er ... maybe ... the way questions are asked ...

R: Mm.

MPT 05: ... now it's gonna be in this way.

R: Okay.

MPT 05: Okay. Whereas when I'm ... when I'm looking at the Fundisa, Fundisa was capacitating us, giving us other ways, since I mentioned about ... Er ... ways of introducing topics ...

R: Yah.

MPT 05: ... Er ... getting new ... getting new ... Er ... information.

R: Content.

MPT 05: Content.

R: Okay.

MPT 05: Yah, knowledge-wise.

R: Okay. okay. And then what challenges did you experience if any in implementing CAPS at your school before attending Fundisa for Change training? Were there any challenges maybe that you were facing of which the training was able to address?

MPT 05: Er ... the ... the ... what I can say was a challenge I think both before when we were teaching we used to know the old syllabus, the old curriculum ...

R: Mm.

MPT 05: ... and only to find that now in CAPS you need to always refer to the CAPS document ...

R: Mm.

MPT 05: ... because you'll find that certain topics are no longer taught in the Grades they were taught in the old curriculum.

R: Mm. Mm. So in terms of content, were there no concepts maybe that were ... weren't there any concepts that maybe you struggled with which were addressed at the training, when you got to ... when you got the Fundisa for Change workshop?

MPT 05: With Fundisa, no, I will say that there was not much challenge.

R: Okay.

MPT 05: Yah.

R: Okay, the in terms of support, did you get any material from Fundisa for Change, that you were able to use after the training, but maybe which you didn't have before the training?

MPT 05: Yah. The ... they did give us the information from the discs, the prepared disc was on Fundisa, it was having information, based on Biodiversity, Biomes, the topics that ... they were catering ...

R: Mm.

MPT 05: ... in Grade 10.

R: Okay, and then the file? Did you get any resource material in terms of the booklets?

MPT 05: Yah. They gave us booklets.

R: Okay. And did you find them being helpful?

MPT 05: Yah, they are helpful enough.

R: Okay.

MPT 05: They are helpful enough.

R: Okay. Okay. But other than the Fundisa for Change, is there any other support that you get in implementing CAPS? Or is it only the Departmental one that you are talking about?

MPT 05: [Interrupting] The Departmental one. Mm. Honestly, there is one for ... [NOT CLEAR] for Maths and Science.

R: Okay. So in terms of these concepts, that were addressed during the ... the training: Ecosystems, Biodiversity, Taxonomy and Human-Environment Relationships, how would you ... Er ... maybe classify your knowledge before and after the training? So here, for instance, if you talk of Ecosystems maybe you'd say: before the training my knowledge was somewhere here [showing participant], it was not bad but it needed improvement, but after the training, then it was strong and completely adequate.

MPT 05: Okay.

R: Mm. So what can you say with Ecosystems?

MPT 05: Yah, with Ecosystems, let me say it was not bad.

R: It was not bad.

MPT 05: Yah.

R: And then after the training it was ..

MPT 05: Yah it was ...

R: ... completely strong?

MPT 05: ... it was strong, yah.

R: Completely adequate. Okay. And then in terms of Biodiversity?

MPT 05: Biodiversity, on that one I was ... it was strong

R: Mm. Mm.

MPT 05: It was strong.

R: Mm.

MPT 05: Yah. I'm looking at my ... my ... participation during the course.

R: Okay. Okay. So do you have a background from your previous studies?

MPT 05: Yah.

R: Okay. And then Taxonomy?

MPT 05: Taxonomy as well.

R: Okay.

MPT 05: Mm.

R: Okay. So it's something that you studied.

MPT 05: Yes, it's something that I studied at tertiary.

R: Okay. So there wasn't ... you say there wasn't much impact.

MPT 05: Yah.

R: Okay. And then Human-Environment Relationships?

MPT 05: Yah, Human-Environment [Relationships] as well I had information ...

R: Mm.

MPT 05: ... on that one. I did environmental stuff, it was made part of my work.

R: Your studies, okay.

MPT 05: My studies.

R: So ... was there any other concept maybe that you struggled with but which was addressed in the training?

MPT 05: [Thinking] The Biomes one. The Biomes.

R: Mm.

MPT 05: Well I had information but it was not enough.

R: [Interrupting] Okay.

MPT 05: So after the training I got ... I got facilitated and it was ... I was cool.

R: Okay.

MPT 05: Mm. I had clear understanding now.

R: Okay.

MPT 05: Yah.

R: And then what teaching methods do you normally use in class? And maybe considering even this lesson that you presented.

MPT 05: Er ... I use presentation ...

R: Okay.

MPT 05: ... and ask questions ...

R: Mm. Mm.

MPT 05: ... finding prior knowledge.

R: Okay.

MPT 05: Then you see the level of the particular content of the thing that you are talking about ...

R: Okay.

MPT 05: ... from the side of the learners.

R: Okay. So that will be the question-and-answer method.

MPT 05: Yes.

R: Okay. So any other method? In this one, in this particular ... lesson ... Biodiversity lesson ... what did you use? Did you take them out?

MPT 05: Yes, I took them out.

R: Mm.

MPT 05: Yah, just to ... to show them identifying, classifying organisms ... the Biodiversity.

R: Okay.

MPT 05: Mm.

R: Okay. Why in particular did you want them to go out?

MPT 05: To ... to ... to have ... to have the feeling ...

R: Okay.

MPT 05: ... and understanding. I think when they're doing things practically ...

R: Mm.

MPT 05: ... they understand it ... very well.

R: Okay.

MPT 05: Mm.

R: Okay. And then in terms of Er ... assessment methods, what assessment methods do you normally use and even here in this lesson? What did use, did you use tests?

MPT 05: Tests, yah. I used tests.

R: Okay.

MPT 05: Mm. I used practicals.

R: Why did you use a practical or a test?

MPT 05: Why did I use that?

R: Mm.

MPT 05: To see whether the students learnt something.

R: Okay. And then in terms of the skills you also assess.

MPT 05: Yah. I also assess the skills.

R: Okay.

MPT 05: Mm.

R: Okay. So are there any new assessment methods that you learnt when you were there, or any new teaching methods that you learnt when you were there at the training, Fundisa for Change training?

MPT 05: In Fundisa, yah, there is something that I learnt which was new of which we were not using ...

R: Mm.

MPT 05: ... the one for the ... the worksheet.

R: Okay.

MPT 05: Yah. So I found it also as a ... a good strategy as well.

R: Okay.

MPT 05: Mm.

R: Okay. And then the teaching method? Were there any new teaching methods?

MPT 05: For teaching methods, it's just the ones we were using.

R: Mm.

MPT 05: Mm.

R: Okay. Because we normally talk about the role-plays, it could be debating also, you know ...

MPT 05: Mm.

R: ... experiential methods, also you were conversant with those ones, you were clear with them.

MPT 05: [Interrupting] Yah, I was clear.

R: Okay. And then the ... teaching and learning support materials that you use in teaching Biology ... I mean Biology or Biodiversity? I think you mentioned some of them, neh?

MPT 05: Yah.

R: For this ... for this particular class also or lesson? You talked of ... the books ...

MPT 05: [Interrupting] I talked of the books.

R: ... internet.

MPT 05: Internet.

R: Learners ... do learners have books?

MPT 05: Yah.

R: Do they all have books?

MPT 05: They all have books.

R: Okay.

MPT 05: Mm. You find that when I go out there we take pictures.

R: Okay.

MPT 05: We take pictures and project them.

R: Okay. Okay. So how has this training influenced you in ... in the use of teaching and learning support material, when teaching Biodiversity? Were there maybe some ... you know ... teaching and learning support materials that you were not using often in class, but when you went there you found that okay, this is what is helpful and I'm gona go back and use it, time and time again?

MPT 05: Yah. The one ... we normally used ... too much of the theory ...

R: Mm.

MPT 05: ... before ...

R: Mm

MPT 05: ... you see.

R: Mm.

MPT 05: But I've noticed that taking learners out and view the ... the thing that you are talking about ... that one has more influence.

R: Okay.

MPT 05: Yah.

R: Okay. And then what experiences of Fundisa for Change programme have been significant to you? What did you like about it, about the training itself, or the programme itself? And how do you think they can improve going forward? Because they are still gonna train more teachers. So which aspects of the training did you like, and which aspects do you think they need to improve on?

MPT 05: Er ... I like the ... I like the outing. When going out, that's where you ... you get the feel and gain information right. The information about what is actually going out there. You see?

R: Mm.

MPT 05: Mm. And I think ... I think they are right. In terms of improvement, I think they are right.

R: Okay.

MPT 05: Yah.

R: Then in terms of content, do you think it was ... I mean ... good for them to teach about the content ... I mean the concepts that are mentioned there, those were the ones that were emphasized

...

MPT 05: Yah.

R: ... so do you think it was worthwhile to teach teachers about those particular ...

MPT 05: [Interrupting] Yah.

R: ... or to provide knowledge to the teachers about some of the concepts?

MPT 05: Yah. It was a good idea. It's a good idea, in my understanding because some of the educators they ... they didn't have ... much information based on these.

R: Mm.

MPT 05: You see?

R: Okay. And then in terms of time, the training was run over how many days?

MPT 05: I think it was three. It was ... three days ... Friday, Saturday ... Friday, Saturday, and Sunday.

R: Okay.

MPT 05: Yah.

R: Okay. And do you think that was enough, unlike most ... well some of the CAPS training run by the Department, you'll find that it's one or two days, so this one was extended.

MPT 05: [Interrupting] It was extended.

R: Do you think it was also worthwhile to do that?

MPT 05: Yah. It was worthwhile.

R: Mm.

MPT 05: It's like when teaching people, when teaching or facilitating a group, you do need time ...

R: Okay.

MPT 05: You do need time to grasp whatever thing was being taught.

R: Mm. Mm.

MPT 05: Mm.

R: And then in terms of follow-up ... Er ... you went for a training and then after that you were given this task to do.

MPT 05: Yes.

R: Portfolio. Do you think it was also worthwhile?

MPT 05: [Interrupting] It was also worthwhile, yah. They did follow-up. They were always on phone, calling us, "smsing" us ...

R: Mm.

MPT 05: ... finding out ... where we were ...

R: Mm.

MPT 05: ... with the ... with the files ...

R: Mm.

MPT 05: ... or portfolios.

R: But how did you experience you know this compilation of portfolio? Was it challenging?

MPT 05: Not it was ...

R: ... or was it also good in the sense that it was related to the class activities?

MPT 05: No it wasn't ... it wasn't challenging.

R: Mm.

MPT 05: The only ... the only problem I think the first day was time.

R: Okay.

MPT 05: Time factor.

R: Time factor.

MPT 05: Yah. I didn't have ... time because at the same time I was busy, it's school work ...

R: Mm.

MPT 05: ... we're having long classes ...

R: Mm.

MPT 05: ... on the other hand we had to prepare this. Also it uses my attention.

R: Mm.

MPT 05: Yah.

R: Okay. And maybe to conclude on the training part of Fundisa for Change, how do you think it has impacted on you generally, maybe in term of teaching, in terms of how you assess learners, yah in terms of teaching methods, in terms of how you associate with nature and how your learners also associate with nature?

MPT 05: Yah, well it ... it really helped me a lot.

R: Mm.

MPT 05: It helped me a lot in such a way that ... I'm finding ways easily to make ... to make learners ... Er ... have the love of nature.

R: Okay.

MPT 05: You see?

R: Okay.

MPT 05: So it has impacted ... it had great impact on me, generally speaking.

R: Okay. Okay. And then coming to the lesson, this lesson that you presented, what did you want learners to ... to achieve from that lesson? What were the objectives?

MPT 05: The main objective was to ... I wanted learners to know, because since we are grooming these learners to ... to make sure they take care of the environment.

R: Mm.

MPT 05: Yah.

R: Mm.

MPT 05: Making sure that whatever thing they do, they ... they make sure that the environment is not ... Er ... affected. They don't ... they don't ... everything they do, it is environmentally friendly.

R: Okay. Okay.

MPT 05: Yah.

R: Okay. Okay. So do you think the objectives of the lesson were achieved?

MPT 05: Were achieved. Yah.

R: Okay. Can you cite an example?

MPT 05: We talk of taking care of the environment, planting trees.

R: Mm.

MPT 05: The learners were now able to green the environment, you see? They used to plant trees. They did this thing voluntarily.

R: Mm.

MPT 05: You see that they've got the love of that particular activity.

R: Mm. Okay. So for that particular class, you said in terms of teaching methods you ... they were working in groups, right?

MPT 05: Yah.

R: And presenting.

MPT 05: And presenting, even when I was taking them out, I grouped them.

R: Okay.

MPT 05: I grouped them.

R: Okay. Why would you group them or ... why did you group them?

MPT 05: I wanted them to ... to have a common idea or understanding. I gave them a task, you are dealing with plants, different plant organisms ...

R: Okay.

MPT 05: ... and then this group, you are looking at insects, the insects that you are finding at this particular zone, or place.

R: Okay. So in that way ...

MPT 05: In that way I was ... I wanted them to ... to classify them.

R: Mm. Mm.

MPT 05: To classify. To see the differences between these organisms ...

R: Okay.

MPT 05: ... while they are found in the same environment.

R: Okay. And at same time they were teaching each other.

MPT 05: Yah.

R: Okay. Okay. And then ... Er ... where did you draw your knowledge from, the knowledge of the content for that particular lesson?

MPT 05: Where did I?

R: Where did you get the knowledge from? Like when you prepare for the lesson, did you get your knowledge from the Fundisa for Change material, from the internet, from the textbook?

MPT 05: Yah, I got it from the ... from the ... the disk they gave us ...

R: Mm.

MPT 05: ... even using information I got from the training ...

R: Mm. Mm.

MPT 05: ... then to prepare I always use the textbook since it was my resource.

R: Okay. And then what challenges did you experience in teaching that particular topic, and how did you maybe overcome them or try to overcome them?

MPT 05: The challenges ... I got the challenge on the learners who are unable to understand. Let me say, from the English perspective [Use of English language].

R: Mm. Mm.

MPT 05: You know. And that's where I started to hold it in vernacular ...

R: [Interrupting] Code switching.

MPT 05: Mm.

R: Okay.

MPT 05: ... in terms of addressing the challenge.

R: Okay. In terms of the number of learners, I mean they were ... were they small enough to handle?

MPT 05: Yah, they were small enough to handle. 28 and 33, are just small classes.

R: Okay. And then in terms of the knowledge, you said they were classifying. Were they using scientific names to classify?

MPT 05: Yah, we used both. We used both, the ... the normal ones ...

R: Mm. Mm.

MPT 05: ... yah.

R: Okay, and learners could just understand?

MPT 05: Yah, they could understand.

R: Okay. Okay. So now if you were to teach this particular lesson ... now or this year, what do you think you can do differently as compared to what you did last year in order to make learners understand, or in order to improve maybe on your practice?

MPT 05: In teaching this, because what I've seen is that when teaching learners such topic as Biodiversity, you don't need to be ... it should not be more of you as an educator, but giving them [Learners] the scope, giving them the chance ... it should be learner-centred, so that they can understand things on their own, and they come with their challenges, they work-out, then you fill

the gap. You fill the gaps. By that I think it helped ... it helped learners, rather than keep spoon-feeding them, spoon-feeding them.

R: Okay.

MPT 05: Yah.

R: Okay. I thank you very much Mr [MP 05], I think we have come to the end of our interview, unless if there is any other point you'd like to raise, either about the lesson or about the training itself, which you think we haven't covered in our discussion.

MPT 05: I think we've covered ... almost all the aspects. What I want to know is that is the training still gonna continue? But you said you are just a researcher [Laughing].

R: But you are free to ask.

MPT 05: Yah.

R: Mm.

MPT 05: Are there still gonna be more training based on ...

R: Environmental content?

MPT 05: ... environmental content?

R: Yes. That's what they ... they are planning to do. But you know at the end of the day it's just funding.

MPT 05: Oh yah.

R: So they are still organizing some funds to ... to run the trainings. So would you want to be invited again for the training?

MPT 05: Yah, I would like to, I would love to.

R: Okay. The reason ... maybe one reason for you to go back again?

MPT 05: Since I did mention that I've got love for nature ... so anything to do with environment ...

R: Mm. Okay.

MPT 05: I'm very much interested in it.

R: Okay. Especially because the environmental knowledge is changing.

MPT 05: Yah, it keeps on changing.

R: Yah, you need to be up-to date with what is happening.

MPT 05: Mm.

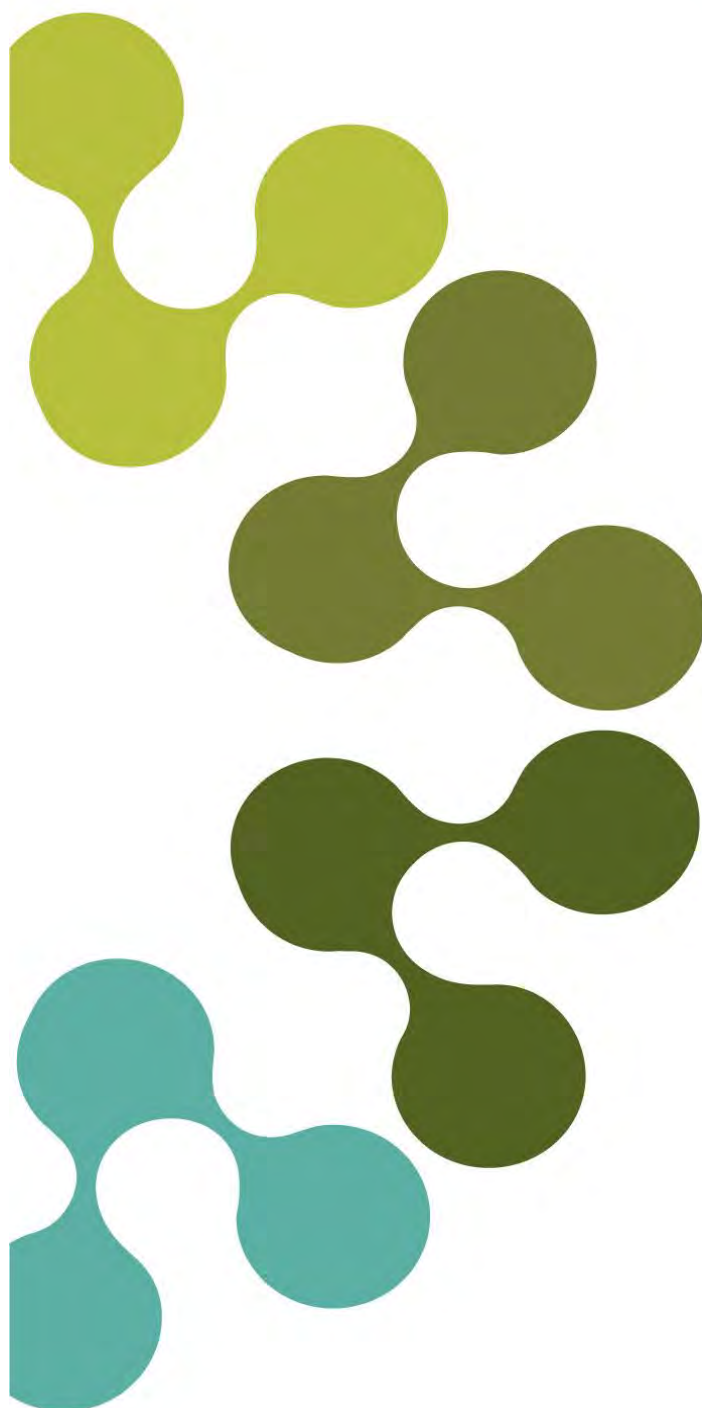
R: But thank you very much, I think this is what Fundisa for Change is striving to ... but since you are the first teachers that they started with I think they will never forget you.

MPT 05: Yah.

R: Yah. Because you are even the people that are supposed to be role models for the other you know incoming teachers in the programme.

MPT 05: Yah. Thank you so much.

R: Alright thank you sir.



Course
Evaluation
2013

Environment



Society



Science



Sustainability

My Starting Points (Pre-course)

1. For how many years have you been teaching Life Sciences?
2. Which grade(s) do you teach?
3. What are your qualifications?
4. Why are you teaching Life Sciences?
5. What teaching methods do you tend to use in teaching Life Sciences?
6. What assessment techniques and tools do you use in teaching Life Sciences?
7. Which textbooks and/or resources do you use when teaching Life Sciences?
8. What factors influence your choice of textbooks and/or resources?
9. What challenges are you encountering in the teaching of Life Sciences?
10. What support is available to you, in teaching Life Sciences?
11. Have you had training on CAPS? If yes, explain the nature of the training.

12. Have you previously participated in workshops and/or courses that deal with environmental concepts? If yes, please list them.

13. Why did you choose to participate in this course?

14. How would you rate your understanding of the following concepts?

Concepts:	Strong, completely adequate	Not bad, but needs improvement	Weak, needs strengthening
Ecosystems			
Please comment on your rating:			
Biodiversity			
Please comment on your rating:			
Taxonomy			
Please comment on your rating:			
Human-environment relationships			
Please comment on your rating:			

Session evaluation

A. Subject content knowledge

1. What biodiversity content knowledge were you hoping to understand more in this course?
2. Was this content sufficiently covered? Please elaborate
3. Are you still experiencing difficulties with particular biodiversity concepts/content knowledge? If yes, please elaborate
4. Could you make links between the biodiversity content knowledge covered and your regular curriculum work? Please elaborate.
5. What new knowledge have you acquired, if at all, which you will use in your teaching?

B. Teaching methods

6. Did the course give you any ideas for extending the different methods you usually use? Please elaborate.
7. Could you make links between the content knowledge that needs to be taught and skills to be developed with teaching methods to teach that knowledge and develop those skills? Please elaborate

C. Assessment

8. Do you feel that the session on assessment will assist you in improving your assessment? If yes, in what way? i.e. How will you be improving your current practice?

9. What is the relationship between how we teach and what we need to assess?

D. Course materials

10. Please comment on the course materials (core text, content knowledge, improving my teaching practice, methods & strategies booklet, other hand-outs). Did these provide you with content knowledge and skills to deepen and improve your practice? Please elaborate.

E. Curriculum

11. What further input do you think you still need with regards to knowing your subject, improving your teaching practice and improving your assessment practice?

F. Facilitation

12. Please comment on the delivery of the course (e.g. expertise and preparedness of the facilitators)

G. General comments

13. Describe aspects of the session that stood out for you.

14. Describe aspects of the session that need to be improved

Appendix F: Document log

Document	Date of production	Who produced the document	Type of document	Main content of document	Value of the document to the research topic
Life Sciences CAPS: Grades 10-12 (LS-CAPS)	2011	DBE	Booklet	It introduces the reader to (1) the curriculum and assessment policy statements in general, and (2) Life Sciences; specifies the content to be covered from Grade 10 to 12, and; describes how Life Sciences in assessed	It helps in answering all the main research questions because it states what content is to be taught and how to assess it. It also suggests possible teaching methods that can be used. Because it is a policy, it shapes the teaching practice in terms of the language being used, the time allocation, resources available, what kind of teacher should be teaching, and what kind of future citizens the country should have.
Fundisa for Change Implementation Plan (IP)	2013	Fundisa for Change	-	It gives the main goal and objectives of the programme; it also gives the rationale behind its establishment; it states the main activities of the programme and the intended results; it also	It helps in getting to understand the main activities in the programme and the expected outcomes within its three year period

				indicates who the stakeholders are in the programme	
Introductory Core Text (CT)	2013	Fundisa for Change	Booklet	It highlights the fact that environment and sustainability content knowledge is changing and contested; it describes the three pillars of teaching practice which are: content knowledge; improve your teaching practice, and; assessment practice	It helps in answering all the main research questions
Teaching Biodiversity: Life Sciences Grades 10-12 (BB)	2013	Fundisa for Change	Booklet	It explains the Biodiversity content knowledge in CAPS, methods of teaching and assessing it.	Helps in answering questions 1 and 2.
Teacher training workshop evaluation forms (E)	2013	Participant teachers	Evaluation forms	Teacher responses on the Biodiversity training attended	Helps in answering all the main research questions.
Teacher portfolios (TP)	2013	Participant teachers	Portfolio	Biodiversity lesson preparation and presentation; teacher reflections on the Biodiversity lesson taught.	Helps in answering all research questions.

Appendix G: NVivo coding

11/24/2014 11:09 AM

Sample of Coding Summary By Node: Interview transcript

Node

Node (Code): Teacher experiences of Fundisa for Change

Aggregate	Classification	Coverage	Number Of Coding References	Reference Number	Coded By Initials	Modified On
PDF						
Source: Interview transcript-ECT 07						
Yes		0.0283	38			
				1	L	11/18/2014 8:02 PM
				You know, ever since I left the university, I never had any ... any other programme that developed me more on Life Sciences.		
				2	L	11/18/2014 8:03 PM
				So I wanted now to get some more things that can make me develop more on Life Sciences		
				3	L	11/18/2014 8:13 PM
				But with Life Sciences most of the lessons you find that it's you who'll do the talking most of the time. So ... I just want really something that can make the Life Sciences to be more more more exciting, just like other science subjects		
				4	L	11/18/2014 8:10 PM
				It's the fieldwork.		
				5	L	11/18/2014 8:29 PM
				we were trying to look at some the connections ...		
				6	L	11/18/2014 8:30 PM
				... of the terms as you move from one Grade to the next.		
				7	L	11/18/2014 9:22 PM
				In ... in Fundisa for Change we were specifically looking at Environmental Studies, I can put it that way		
				8	L	11/18/2014 9:24 PM
				there are new concepts now which are introduced		
				9	L	11/18/2014 9:32 PM
				the Fundisa ... they were trying at least now to make this thing to be so exciting,		

Appendix H: Analytical memo

Teacher experiences of Fundisa for Change training: New teaching method

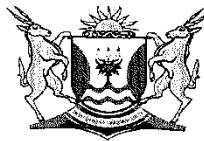
New teaching method – Fieldwork	
Responses	Source
<i>... teach them inside [the classroom] and then [take them] outside to the environment, and identify things. Er ... at a later stage they will know and understand ... when you evaluate them or do an assessment on them.</i>	ECT 05-I
<i>... excursions ...</i>	ECT 05-E
<i>Fieldwork.</i>	ECT 04-E
<i>It's the fieldwork. Fieldwork is really important.</i>	ECT 07-I
<i>... coming to environmental studies, fieldworks are also important ...</i>	MPT 01-E
<i>... taking learners to a field trip. Fieldwork.</i>	MPT 02-I MPT 02-I
<i>Field trip</i>	MPT 02-E

Appendix I: Practice Architectures framework for practice analysis

<i>Elements of practices</i>	<i>Practice architectures in the site</i>	
<p>Project In this cell, we describe what we take to be the <i>project</i> (or <i>telos</i> or purpose) of the practice we are studying, based on the evidence available (for example, the content of a transcript and other related observational, interview or documentary evidence available). When a participant sincerely answers the question 'What are you doing?', they describe the <i>project</i> of the practice (from their perspective).</p>	<p>Practice landscape In this cell, we describe how people and objects are differently enmeshed in the interactions (that is, in the activity-timespace) of the practice being studied. Different people and objects may be involved at different stages or in different episodes or in different aspects of the practice, and they may participate in different roles or from different perspectives. Some objects not apparently relevant to the activities (the ceiling, for example) may in fact play a role in enabling or constraining the practice and in this way be enmeshed in the activity-timespace of the practice.</p>	
<p>Sayings</p>	<p>In the cells on the left, we identify the principal <i>sayings, doings</i> and <i>relatings</i> that compose and 'hang together in' the <i>practices</i> under study; alongside these, on the right, we identify (respectively) the principal <i>cultural-discursive, material-economic</i> and <i>social-political arrangements</i> that are resources that make possible (<i>prefigure</i>) the sayings, doings and relatings we observe. In the analysis, we aim to identify at least the most significant proximal arrangements that shape the sayings, doings and relatings observed (things present in the site), and, where relevant, more distal conditions (like more widespread languages of policy or theory, more extensive material layouts, or wider sets of social relationships in or beyond organisations) that are significantly enmeshed in the practices under study. Together, the cells on the left describe the <i>practice</i> in terms of what is said and done and how people relate in it; together, the cells on the right describe the <i>practice architectures</i> that form the <i>niche</i> (on the model of an ecological niche) that permits the practice to survive in the site.</p>	<p><i>Cultural-discursive arrangements</i></p>
<p>Doings</p>		<p><i>Material-economic arrangements</i></p>
<p>Relatings</p>		<p><i>Social-political arrangements</i></p>
<p>Dispositions (<i>habitus</i>) In this cell, we describe what we take to be the most significant <i>dispositions</i> (or <i>habitus</i>) called on or developed in the principal participants as they participate in the practice. Bourdieu (1990) describes the <i>habitus</i> as a set of dispositions developed by a participant enacting a practice in cultural, material and social fields (for example); these dispositions are what give the participant the 'feel for the game' that makes it possible for them to act appropriately in the field. In our view, dispositions include knowledge, skills and values. <i>Knowledge</i> relates chiefly to the <i>sayings</i> and cultural-discursive resources (in language, in semantic space) present in or brought to the site; <i>skills</i> relate chiefly to the <i>doings</i> and material-economic resources (in activity and work, in physical space-time) at the site; and <i>values</i> relate chiefly to the <i>relatings</i> and social-political resources (in power and solidarity, in social space) at the site.</p>	<p>Practice traditions In this part of the table, we comment on the <i>practice traditions</i> that appear to be in play, reproduced, or transformed in the practice. This sets the interactions that compose the practice against a longer history of practice, including at least the history of practice in the local site (for example, in terms of how the participants have acted and interacted as part of the practice in the site over previous days, months or years). Where relevant, we also comment on the practice interpreted against a broader history of this kind of practice (for example, how practice in a particular classroom might be an expression of a practice tradition like progressive education or a particular approach to literacy education).</p>	

Source: Kemmis et al. (2014, p. 39)

Appendix J: Access letter from EC Education Department



Province of the
EASTERN CAPE
EDUCATION

STRATEGIC PLANNING POLICY RESEARCH AND SECRETARIAT SERVICES

Steve Vukile Tshwete Complex • Zone 6 • Zwelitsha • Eastern Cape
Private Bag X0032 • Bhisho • 5605 • REPUBLIC OF SOUTH AFRICA
Tel: +27 (0)40 608 4773/4035/4537 • Fax: +27 (0)40 608 4574 • Website: www.ecdoe.gov.za

Enquiries: B Pamla

Email: babatwa.pamla@edu.ecprov.gov.za

Date: 08 May 2014

Mr. Lebona Jerome Nkahle
Environmental Learning Research Centre
Faculty of Education
Rhodes University
P.O. Box 94
Grahamstown
6140

Dear Mr. Nkahle

PERMISSION TO UNDERTAKE A MASTERS THESIS: TEACHER PROFESSIONAL DEVELOPMENT IN THE ENVIRONMENT SECTOR – A CASE STUDY OF FUNDISA FOR CHANGE CONTINUING TEACHER PROFESSIONAL DEVELOPMENT PROGRAMME

1. Thank you for your application to conduct research.
2. Your application to conduct the above mentioned research in eight (8) Secondary Schools under the jurisdiction of East London and Mthatha Districts of the Eastern Cape Department of Education (ECDoE) is hereby approved on condition that:
 - a. there will be no financial implications for the Department;
 - b. institutions and respondents must not be identifiable in any way from the results of the investigation;
 - c. you present a copy of the written approval letter of the Eastern Cape Department of Education (ECDoE) to the Chief Directors and Directors before any research is undertaken at any institutions within that particular district;
 - d. you will make all the arrangements concerning your research;



- e. the research may not be conducted during official contact time, as educators' programmes should not be interrupted;
 - f. should you wish to extend the period of research after approval has been granted, an application to do this must be directed to Chief Director: Strategic Management Monitoring and Evaluation;
 - g. the research may not be conducted during the fourth school term, except in cases where a special well motivated request is received;
 - h. your research will be limited to those schools or institutions for which approval has been granted, should changes be effected written permission must be obtained from the Chief Director: Strategic Management Monitoring and Evaluation;
 - i. you present the Department with a copy of your final paper/report/dissertation/thesis free of charge in hard copy and electronic format. This must be accompanied by a separate synopsis (maximum 2 – 3 typed pages) of the most important findings and recommendations if it does not already contain a synopsis.
 - j. you present the findings to the Research Committee and/or Senior Management of the Department when and/or where necessary.
 - k. you are requested to provide the above to the Chief Director: Strategic Management Monitoring and Evaluation upon completion of your research.
 - l. you comply with all the requirements as completed in the Terms and Conditions to conduct Research in the ECDoE document duly completed by you.
 - m. you comply with your ethical undertaking (commitment form).
 - n. you submit on a six monthly basis, from the date of permission of the research, concise reports to the Chief Director: Strategic Management Monitoring and Evaluation.
3. The Department reserves a right to withdraw the permission should there not be compliance to the approval letter and contract signed in the Terms and Conditions to conduct Research in the ECDoE.
 4. The Department will publish the completed Research on its website.
 5. The Department wishes you well in your undertaking. You can contact the Chief Director, Mr. GF Mac Master on the numbers indicated in the letterhead or email greg.macmaster@edu.ecprov.gov.za should you need any assistance.




MIR. GF MAC MASTER
CHIEF DIRECTOR: STRATEGIC MANAGEMENT MONITORING AND EVALUATION
FOR SUPERINTENDENT-GENERAL: EDUCATION



Appendix K: Access letter from MP Education Department

**APPROVAL TO CONDUCT RESEARCH FOR MR. LEBONA J. NKHAHLE:
ENVIRONMENTAL EDUCATION: M.ED DEGREE**



education
DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

Private Bag X 11341
Nelspruit 1200
Government Boulevard
Riverside Park
Building 5
Mpumalanga Province
Republic of South Africa

Litiko leTernfundvo Umyango weFundo Departement van Onderwys Umyango wezehlifundo
Enquiries: H.A. Baloyi (013) 766 6476


**Education Department (ELRC)
Rhodes University
P.O. Box 94
Grahamstown
6140**

RE: APPLICATION TO CONDUCT RESEARCH: MR. LEBONA JEROME NKHAHLE

Your application to conduct research was received on the on the 16 April 2014. The title of your study is: Continuing Teacher Professional Development in the Environment Sector: A case study of Fundisa for Change Continuing Teacher Professional Development Programme. The aims and objectives and the overall design of the study give an impression that the outcomes of the study will improve and sensitize the teachers and learners about the importance of Environmental Education and the associated impact brought about by the changing environment. Your request is approved subject to you observing the content of the departmental research manual which is attached. You are required to discuss with the principals of the sampled schools regarding the approach to your observation and data collection as no disruption of tuition will be allowed. You are also requested to adhere to your University's research ethics as spelled out in your research ethics document.

In terms of the attached manual (2.2. bullet number 4 & 6) data or any research activity can only be conducted after school hours as per appointment. You are also requested to share your findings with the relevant sections of the department so that we may consider implementing your findings if that will be in the best interest of department.

Sisonke Sifundzisa Sive

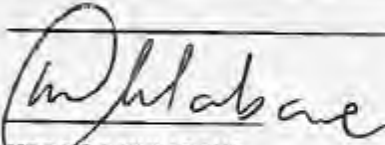


MPUMALANGA
A Pioneering Spirit

**APPROVAL TO CONDUCT RESEARCH FOR MR. LEBONA J. NKHAHLE:
ENVIRONMENTAL EDUCATION: M.ED DEGREE**

For more information kindly liaise with the department's research unit @ 013 766 5476 or a.baloyi@education.mpu.gov.za. The department wishes you well in this important project and pledges to give you the necessary support you may need.

APPROVED/~~NOT APPROVED~~:



MRS MOC MHLABANE
HEAD OF DEPARTMENT

25. 04. 14
DATE

Appendix L: Consent letter for participating teachers

ELRC
Education Department
Rhodes University
P.O. Box 94
Grahamstown, 6140

07 April 2014

The Participating Teacher
..... School

Dear Sir/Madam

I am currently studying Masters in Environmental Education at Rhodes University in Grahamstown, South Africa. It is required of me to conduct and successfully complete a research study in order to qualify for the award of this masters' degree. I have requested for a permission to conduct this research study at your school with Life Sciences teachers who attended a Fundisa for Change teacher-training workshop.

The main goals of this research study are to explore the teachers' experiences of the Fundisa for Change teacher training programme and to find out how this programme impacts on teachers' practice. This research will involve interviewing the participating teachers, and if permitted, the interviews will be audio-recorded. Participation in this study is voluntary and the participating teachers will be fully informed about the purpose of this research, and may withdraw from the study at any time should they wish to. Confidentiality and anonymity regarding the names of the participants and the schools where they work will be strictly adhered to. I will treat the participating teachers with respect, whether young or old, and their views will only be used for this research, and will not be used for other purposes without their permission. There are no known risks involved in this study. The findings of this research study will contribute to existing knowledge on how to best support teachers professionally to improve their classroom practice. It will also provide more opportunities for further research in teacher professional development. If you are willing to participate, please fill in and sign the consent form provided. Thanking you in advance.

Yours faithfully

Lebona Nkhahle (Mr)
Cell: 0735505321
Email: JNKHAHLE@GMAIL.COM

Supervisor: Prof Heila Lotz-Sisitka (046 603 8389)
Co-supervisor: Ms Zintle Songqwaru (046 603 7472)

CONSENT FORM FOR THE PARTICIPATING TEACHER

I, _____ have read the **consent letter** and voluntarily agree to participate. The procedure and goals of the research study have been explained to me by the researcher and I understand them. I understand that I am free to withdraw from this study at any time without penalty. I also understand that although the data from this study may be published, the school or my identity will be kept confidential. I have received a copy of this consent form for my records.

Signature: _____

Date: _____

Appendix M: Consent letter for the school principals

ELRC
Education Department
Rhodes University
P.O. Box 94
Grahamstown, 6140

07 April 2014

The School Principal
..... School

Dear Sir/Madam

RE: REQUEST FOR A PERMISSION TO CONDUCT A RESEARCH STUDY AT YOUR SCHOOL

I am currently studying Masters in Environmental Education at Rhodes University in Grahamstown, South Africa. It is required of me to conduct and successfully complete a research study in order to qualify for the award of this masters' degree. I therefore humbly request for a permission to conduct this research study at your school with Life Sciences teachers who attended a Fundisa for Change teacher-training workshop.

The main goals of this research study are to explore the teachers' experiences of the Fundisa for Change teacher training programme and to find out how this programme impacts on teachers' practice. This research will involve interviewing the participating teachers, and if permitted, the interviews will be audio-recorded. Participation in this study is voluntary and the participating teachers will be fully informed about the purpose of this research, and may withdraw from the study at any time should they wish to. Confidentiality and anonymity regarding the names of the participants and the schools where they work will be strictly adhered to. I will treat the participating teachers with respect, whether young or old, and their views will only be used for this research, and will not be used for other purposes without their permission. There are no known risks involved in this study. The findings of this research study will contribute to existing knowledge on how to best support teachers professionally to improve their classroom practice. It will also provide more opportunities for further research in teacher professional development. If the school is willing to participate, please fill in and sign the consent form provided. Thanking you in advance.

Yours faithfully

Lebona Nkhahle (Mr)
8389)
Cell: 0735505321
7472)
Email: JNKHAHLE@GMAIL.COM

Supervisor: Prof Heila Lotz-Sisitka (046 603
Co-supervisor: Ms Zintle Songqwaru (046 603

CONSENT FORM FOR THE PRINCIPAL

I, _____ have read the **consent letter** and voluntarily allow the school to participate. The procedure and goals of the research study have been explained to me by the researcher and I understand them. I understand that I am free to withdraw the school from this study at any time without penalty. I also understand that although the data from this study may be published, the school or participant identity will be kept confidential. I have received a copy of this consent form for my records.

Signature: _____

Date: _____

Appendix N: Consent letter for teacher-trainers

ELRC
Education Department
Rhodes University
P.O. Box 94
Grahamstown, 6140

07 April 2014

.....
.....

Dear Sir/Madam

I am currently studying Masters in Environmental Education at Rhodes University in Grahamstown, South Africa. It is required of me to conduct and successfully complete a research study in order to qualify for the award of this masters' degree.

The main goals of this research study are to explore the teachers' experiences of the Fundisa for Change teacher training programme, to find out how this programme impacts on teachers' practice, and to explore the practices of Fundisa for Change programme which are characteristic of effective continuing teacher professional development initiatives. This research will involve interviewing the participating teachers, and if permitted, the interviews will be audio-recorded. It will also involve interviewing a teacher trainer conducting the training workshop. Participation in this study is voluntary and the participants will be fully informed about the purpose of this research, and may withdraw from the study at any time should they wish to. Confidentiality and anonymity regarding the names of the participants and the organisations where they work will be strictly adhered to. I will treat the participants with respect, whether young or old, and their views will only be used for this research, and will not be used for other purposes without their permission. There are no known risks involved in this study. The findings of this research study will contribute to existing knowledge on how to best support teachers professionally to improve their classroom practice. It will also provide more opportunities for further research in teacher professional development. If you are willing to participate, please fill in and sign the consent form provided. Thanking you in advance.

Yours faithfully

Lebona Nkhahle (Mr)
603 8389)
Cell: 0735505321
(046 603 7472)
Email: JNKHAHLE@GMAIL.COM

Supervisor: Prof Heila Lotz-Sisitka (046

Co-supervisor: Ms Zintle Songqwaru

CONSENT FORM FOR THE PARTICIPATING TEACHER TRAINER

I, _____ have read the **consent letter** and voluntarily agree to participate. The procedure and goals of the research study have been explained to me by the researcher and I understand them. I understand that I am free to withdraw from this study at any time without penalty. I also understand that although the data from this study may be published, my organisation's or my identity will be kept confidential. I have received a copy of this consent form for my records.

Signature: _____

Date: _____

Appendix O: Ethical clearance letter



RHODES UNIVERSITY
Grahamstown • 6140 • South Africa

CENTRE FOR HIGHER EDUCATION RESEARCH, TEACHING AND LEARNING
P O Box 94, Grahamstown, 6140, South Africa
Email: chertl-admin@ru.ac.za
Tel: +27 (0)46 603 8171/3
Fax: +27 (0)46 622 8587

8 April 2014

To whom it may concern

Approval of M.Ed proposal and ethical clearance:

Lebona J. Nkhahle (Student number: g13N8128)

Provisional Title: Continuing Teacher Professional Development in the Environment
Sector: A Case Study of Fundisa for Change Continuing Teacher Professional
Development programme

Supervisors: Professor Lotz-Sisitka and Ms Songqwaru

This letter confirms the approval of the above proposal at a meeting of the
Faculty of Education Higher Degrees' Committee on 7 November 2013.

In the event that the proposal demonstrates an awareness of ethical
responsibilities and a commitment to ethical research processes, the approval of
the proposal by the committee constitutes ethical clearance. This was the case
with this proposal and the committee thus approved ethical clearance.

Yours sincerely

Prof S. McKenna
Chairperson of Education Higher Degrees' Committee
s.mckenna@ru.ac.za

Appendix P: Biodiversity content in Life Sciences CAPS

TERM 3 - Grade 10

Strand 3: Environmental Studies

Organisms interact with other organisms and with the environment in which they live in order to survive and produce offspring. The study of these interactions is called ecology. This section is structured to expose learners to some of the interactions that occur in nature and to the terminology and concepts that describe them. For the Grade 11 curriculum, the terminology and concepts selected here will be used across all strands, where appropriate. This will enable learners to contextualise the meaning of these terms and concepts within the familiar contexts of their local area as well as Southern Africa as a whole. The local area context is also used to introduce how humans influence the environments in which they and other organisms live. The effect man has on the environment – both locally and globally - will be examined in more detail in Grade 11. This section also builds on the knowledge that has been acquired during the Senior Phase.

Time	Topic	Content	Investigations	Resources
6 weeks (24 hours)	Biosphere to Ecosystems	<p>Biosphere</p> <ul style="list-style-type: none"> The concept of the biosphere. The inter-connectedness with and component of the global ecosystem: the hydrosphere, lithosphere and atmosphere (<i>Link to Grade 8</i>). <p>Biomes</p> <ul style="list-style-type: none"> Terrestrial and aquatic biomes of the 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) 	<p>Fieldwork</p> <p>Choose ONE ecosystem (close to the school) within a local biome for</p>	<ul style="list-style-type: none"> Textbooks Identification guides and keys to groups of organisms

<p>Total: 9 weeks (36 hours)</p>		<ul style="list-style-type: none"> - 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 (<i>link to pollution-Grade 12</i>); and - wind (<i>link to transpiration</i>). • Biotic factors, which include: (<i>Links to Grade 8</i>) <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 (<i>link with Grade 9 and nutrition in Grade 11</i>); - Flow charts of the following: nutrients water, oxygen, carbon and nitrogen cycles (Names, e.g., nitrates are required but no details of chemistry is necessary) • Ecotourism <ul style="list-style-type: none"> - economics - ethics - opportunities 	<p>special study. The study must:</p> <ul style="list-style-type: none"> • deal with abiotic and biotic factors and the interactions between them; • the trophic relationships in an ecosystem; • record and describe seasonal changes over two terms either Terms 1 and 2 or Terms 3 and 4 • biodiversity within the ecosystem using field guides and keys • positive and/or negative human impact on the ecosystem <p>Different groups should investigate different factors. Each group must plan, collect, record and present, analyse and evaluate data. (<i>This serves as an introduction/link to human influences on the environment in Grade 11.</i>)</p>	<ul style="list-style-type: none"> • Access to an ecosystem • Map of South Africa • DVDs • The internet • Nature programmes on TV • Local information • Appropriate instruments for measuring abiotic factors.
<p>Assessment</p>	<ul style="list-style-type: none"> • One formal recorded class test. • Assessment for learning (informal) using a variety of strategies and 	<p>One practical task</p> <p>Refer to the range of skills specified under Specific Aim 2.</p>		

	<p>appropriate forms of assessment in written worksheets, homework exercises, summaries, reports, essays, etc. Refer to range of skills specified in Specific Aims 1 and 3.</p> <p>Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to the knowledge and understanding of investigations.</p>	
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TERM 4 - Grade 10

Strand 4: Diversity, Change and Continuity

Life exists in a huge array of forms and modes of life which scientists organise according to man-made classification systems. Modern life forms have a long history, extending from the first bacteria, around 3,5 billion years ago. South Africa has a rich fossil record of some key events in the history of life forms. Changes in life forms are related to climate change as well as movements of continents and oceans over long periods of time.

Time	Topic	Content	Investigations	Resources
<p>1 week (4 hours)</p>	<p>Biodiversity and Classification</p>	<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 Classification Schemes are a way of organising biodiversity • Brief history of classification: Scientists attempt to classify organisms based on shared features. As information increases classification changes. One of the currently accepted classification 	<ul style="list-style-type: none"> • Principles of classification by grouping everyday objects on the basis of shared similarities into simple nested hierarchy. 	<ul style="list-style-type: none"> • Textbooks • Photographs • Micrographs • A selection of everyday objects • Identification guides • Keys to groups of organisms

		<p>systems is the five-kingdom system: Animalia, Plantae, Fungi, Protista and Monera (Bacteria).</p> <ul style="list-style-type: none"> • 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 (<i>link to cell structure</i>). • The main groupings of living organisms, diagnostic features of each <ul style="list-style-type: none"> - Bacteria - Protista - Fungi - Plants - Animals 	<ul style="list-style-type: none"> • Classify a selection of familiar organisms into groups based on visible evidence. Use keys and identification guides. 	<ul style="list-style-type: none"> • Identification guides • Keys • Photographs
Assessment	<ul style="list-style-type: none"> • One formal recorded class test • One project/assignment • End of year examination (2 x 2¹/₂ hours) <p>Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in written exercises, summaries, essays, tests, etc. Refer to range of skills specified in Specific Aims 1 and 3.</p> <p>Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to the knowledge and understanding of investigations.</p>			<p>Practical examination (1 hour)</p> <p>Note: The practical work done during the year must develop the range of skills described in Specific Aim 2. The practical examination will assess some of these skills.</p>
TERM 1 – Grade 11				

Strand 1: Diversity, Change and Continuity

Life exists in a wide variety of forms which live in different niches. This selection enables learners to be exposed to an array of life forms from microorganisms to macroscopic plants and animals. These are organised according to a man-made system of classification based on observable features. Learners explore the roles of organisms in an ecosystem including microorganisms that are a major cause of diseases. The strand also includes some evolutionary development in plant and animal phyla.

Time	Topic	Content	Investigations	Resources
3 weeks (12 hours)	Biodiversity and Classification of Microorganisms	<p>Biodiversity</p> <ul style="list-style-type: none">• Microorganisms: basic structure and general characteristics of the following groups (<i>links with Grade 9 and 10</i>)<ul style="list-style-type: none">- viruses- bacteria- protista- fungi. <p>(Macroscopic organisms in the protista and fungi should only be mentioned – not studied in any detail)</p> <ul style="list-style-type: none">• Mention of the roles that these groups play in maintaining balance in the environment and web of life.• Symbiotic relationships, including, nitrogen fixing bacteria in plants and <i>E. Coli</i> in the human intestine (<i>link with Grade 10</i>).• The effect of management of one disease from each of the four groups:<ul style="list-style-type: none">- viruses (rabies, HIV/AIDS, influenza)- bacteria (blight, cholera, tuberculosis, anthrax)- protists (malaria)- fungi (rusts, thrush, ringworm, athlete’s foot).• Immunity, including plants and animals’ immune responses against the infecting microorganism Vaccinations (briefly).	<ul style="list-style-type: none">• Where possible, the prevalence of bacteria/fungi should be demonstrated by growing cultures on agar plates, or bread mould (fungus) on bread. • Look for evidence of bacteria/fungal diseases on plants (school and home). Map the distribution of one disease in the study area.	<ul style="list-style-type: none">• Textbooks• Reference books• Charts• Agar• Petri dishes• Hand lenses

		<ul style="list-style-type: none"> • The use of drugs, e.g., antibiotics, effect on microorganisms • The use of microorganisms to produce medicines (e.g., insulin and antibiotics). • Traditional technology to produce, e.g., beer, wine and cheese. 		
3 weeks (12 hours)	<p>Biodiversity of plants (Focus on the Developmental Lines and Not on In-Depth Studies of Life Cycles. Learners should have a basic understanding of Phylogenetic Trees as reconstructions of evolutionary pathways) and cladograms</p> <p>Reproduction in Plants</p>	<ul style="list-style-type: none"> • Grouping of bryophytes, pteridophytes, gymnosperms and angiosperms according to the presence/absence of: <ul style="list-style-type: none"> - vascular tissue (xylem and phloem) - true leaves and roots - seeds or spores - fruit <p>Decreasing dependence on water from reproduction from Bryophytes to Angiosperms</p> <ul style="list-style-type: none"> • Asexual and sexual reproduction name advantages and disadvantages of each, • Flowers as reproductive structures Adaptations for pollination through (different pollinators) wind, insects and birds (South African example only) differences and similarities 	<ul style="list-style-type: none"> • Observe and draw relevant macroscopic parts to provide examples of each of the following divisions: <ul style="list-style-type: none"> - bryophytes: moss plant - pteridophytes: rhizome, frond with sori - gymnosperms : needles, cones and seeds; and - angiosperms: flower, fruit and seeds. • Draw a phylogenetic tree showing evolutionary history of the four plant groups and major structural changes in their history of development. • Dissect an example of each of the following types of flowers: <ul style="list-style-type: none"> - Wind pollinated 	<ul style="list-style-type: none"> • Textbooks • Plant specimens • Identification guides/keys • Hand lens • Micrographs • Charts • Models • Microscopes • Prepared slides <p>Various flowers Scalpels or blades Hand lenses Micrographs</p>

		<ul style="list-style-type: none"> • The Significance of seeds <ul style="list-style-type: none"> - Seed banks; - Seeds as a food source; and - Endemic species in South Africa 	<ul style="list-style-type: none"> - Insect pollinated - Bird pollinated <p>Record observations in a comparable table. Optional: Germinate seeds: record process</p>	Seeds
<p>2 weeks (8 hours)</p> <p>Biodiversity of Animals with a focus on six of the major phyla</p> <p>(Focus on the Developmental Lines and Phylogenetic Trees. No further Details are Required regarding the Morphology of the Six Phyla).</p>	<ul style="list-style-type: none"> • The relationship between the body plan and grouping of animals in phyla. The concept of a phylum. • Six phyla (out of about 30 in the animal kingdom): <ul style="list-style-type: none"> - Porifera - Cnidaria - Platyhelminthes - Annelida - Arthropoda - Chordata • Key features in respect of body plans: <ul style="list-style-type: none"> - symmetry and cephalisation; - the number of tissue layers developed from embryo; - the number of openings in the gut; - coelom and blood systems. • The relationship between body plans and modes of living for each of the six phyla; similarities and differences. • The role of invertebrates in agriculture and ecosystems (e.g., pollination, decomposition, soil aeration etc.) 	<ul style="list-style-type: none"> • Calculate approximate surface area to volume ratios of selected examples. • Observe examples from as many phyla as possible (photographs/DVDs). • Select one phylum and design a poster to show diversity in that phylum in South Africa • Construct a comparative table of these four key features in the six selected phyla. 	<ul style="list-style-type: none"> • Textbooks • Reference books • Photographs • DVDs if possible 	
Total 8 weeks (32 hours)				
Assessment		<ul style="list-style-type: none"> • One formal recorded class test. 	<ul style="list-style-type: none"> • One practical task 	

	<ul style="list-style-type: none"> Assess learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework exercises, worksheets, reports, summaries, essays, etc. <p>Refer to range of skills specified in Specific Aims 1 and 3. Note that knowledge and understanding to investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to the knowledge and understanding of investigations.</p>	<ul style="list-style-type: none"> Refer to the range of skills specified under Specific Aim 2.
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TERM 3 – Grade 11

Strand 3: Environmental Studies

Organisms interact with other organisms and with the environments in which they live. This section is structured so that learners must explore the impact of people on their environments (global, international and local). Learners are encouraged to look for and suggest solutions to local environmental problems. The intention is that learners will become more informed and more sensitive to environmental issues and will modify their behaviour to lessen their impact on the environment

Time	Topic	Content	Investigations	Resources
4 weeks (24 hours)	Population Ecology	<ul style="list-style-type: none"> Population Size Immigration, emigration, mortality. Fluctuations. Limiting factors and carrying capacity. Logistics and geometric growth curves with phases. 	<ul style="list-style-type: none"> Determine the size of a population by quadrant or simple sampling e.g., simulated mark/recapture. Collect and record data, Interpret data Calculate/estimate the population size. Case study: Rationale for culling, e.g. elephants in the Kruger National Park as an example of an application of 	<ul style="list-style-type: none"> Textbooks Reference books Posters Charts Brochures

		<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 benefit - mutualism: two examples from South Africa; both species benefit - commensalism: two examples from South Africa 	<p>estimating population size (link to researched reasons for culling).</p> <ul style="list-style-type: none"> • Draw up a public survey form to test the public opinion about culling. Show results in a pie graph. <ul style="list-style-type: none"> • Draw a life cycle of the bilharzias parasite or tapeworm (simplify larval stages). (Links to animal biodiversity) • Identify an area in or close to the school grounds where succession 	<ul style="list-style-type: none"> • DVDs • Newspapers • Magazines • Watching nature programmes on TV
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<p>Total 9¹/₂ weeks (38 hours)</p>		<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 distribution 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 	<p>is taking/has taken place. (e.g., in the goal area on the sports field at the end of a season or a roadside that has been scraped).</p>	
<p>Assessment</p>	<ul style="list-style-type: none"> • One formal recorded class test. • Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework exercises, worksheets, reports, summaries, essays, etc. <p>Refer to the range of skills listed under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to the</p>	<ul style="list-style-type: none"> • One practical task. • Refer to the range of skills specified in Specific Aim 1. 		

	knowledge and understanding of investigations.	
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TERM 4 – Grade 11

Strand 3 Environmental Studies (Continued): Human Impact on the Environment

Note: 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.

Time	Topic	Content	Investigations	Resources
7 weeks (28 hours)	Human Impact on the Environment: Current Crises for Human Survival: Problems to be Solved Within the Next Generation	<p>Causes and consequences of the following (relate to conditions and circumstances in South Africa):</p> <ul style="list-style-type: none"> • The atmosphere and the 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 - Wastage - Costs of water • Quality 	<ul style="list-style-type: none"> • Practical observation of ONE example of human influence on the environment in the local area (e.g., the impact of alien species on biodiversity). Written report on the chosen example. 	<ul style="list-style-type: none"> • Textbooks • Reference books • Reports in the media • Share-Net booklets

		<ul style="list-style-type: none"> - Water for domestic use, industry, agriculture and mining: pollution, diseases, eutrophication and algal bloom. - The effect of mining on quality of water - Thermal pollution - The need for water purification and recycling - Alien plants, e.g., <i>Eichornia</i> • Food security (<i>link with population ecology dynamics</i>) <ul style="list-style-type: none"> - human exponential population growth; - droughts and floods (climate change); - poor farming practices: monoculture; pest control, loss of topsoil and the need for fertilisers; - alien plants and reduction of agricultural land; - the loss of wild varieties: impact on gene pools; - genetically engineered foods; - wastage. • Loss of Biodiversity (the sixth extinction) <ul style="list-style-type: none"> - habitat destruction: farming methods, e.g., overgrazing and monoculture, golf estates, mining, urbanisation, deforestation; loss of wetlands and grasslands; - poaching, e.g., for rhino horn, ivory and ‘bush meat’; 	<ul style="list-style-type: none"> • Rhino poaching in South Africa: read articles and make suggestions on how it can be prevented. 	
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<p>Total 7 weeks (28 hours)</p>		<ul style="list-style-type: none"> - alien plant invasions: control using mechanical, chemical and biological methods; and - indigenous knowledge systems and the sustainable use of the environment e.g., devils' claw, rooibos, fynbos, the African potato (<i>Hypoxis</i>) and <i>Hoodia</i>. • Solid Waste Disposal <ul style="list-style-type: none"> - managing dumpsites for rehabilitation and prevention of soil and water pollution; - the need for recycling; - using methane from dumpsites for domestic use: heating and lighting; and - safe disposal of nuclear waste. 	<ul style="list-style-type: none"> • Analyse the solid waste generated in the household in one week, including paper, metals and plastic. Estimate the percentage that could be recycled or reused. • Visit a municipal landfill site, or a local refuse dump. Observe rehabilitation (or lack thereof) in practice. • Assess the effectiveness of waste management. 	
<p>Assessment</p>		<ul style="list-style-type: none"> • One formal recorded class test • One project/assignment • End of year examination: 2 x 2¹/₂ hours. • Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework exercises, worksheets, reports, summaries, essays, etc. <p>Refer to the range of skills listed under Specific Aims 1 and 3.</p>	<p>One practical exam (1 hour)</p>	

	<p>Note that knowledge and understanding to investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to the knowledge and understanding of investigations.</p>	<p>Note: Refer to the range of skills specified in Specific Aim 2.</p>

(Source: LS-CAPS, pp. 33-53)

Appendix Q: Fundisa for Change objectives, main activities and intended results for the period: 2013-2015

OBJECTIVE	Achievable results by Dec 2015
<p>OBJECTIVE 1: CAPACITY BUILDING FOR TEACHER EDUCATORS</p> <p><i>Activity 1.1</i> Establish and implement a Training of Trainers programme</p> <p><i>Activity 1.2</i> Develop Teacher Education Materials</p> <p><i>Activity 1.3</i> Ensure Accredited Programmes and seek SACE recognition</p> <p><i>Activity 1.4</i> Support partners and trainers to implement Training of Teachers programmes</p> <p><i>Activity 1.5</i> Investigate and establish mechanisms to share and adapt materials (open source and/or print)</p>	<p>9 Training of Trainers Programmes Implemented 100 Trainers with capacity to implement the Fundisa for Change programmes</p> <p>30 Fundisa for Change teacher education units (for use in teacher education programmes)</p> <p>Assessment tools and Accreditation Frameworks in place for all Fundisa for Change programmes offered to teachers.</p> <p>30 Teacher Clusters Trained to implement environmental learning focus in their Subjects, supported by Fundisa for Change materials and accredited training programme.</p> <p>Strategy and exemplary practices for sharing materials established and tested out (e-learning, print etc.)</p>
<p>OBJECTIVE 2: POLICY AND ADVOCACY INFLUENCE:</p> <p><i>Activity 2.1</i> Establish a National Environmental Sector Skills Forum Working Group, develop and implement a Fundisa for Change advocacy strategy</p> <p><i>Activity 2.2</i> Engage with key policy forums and issues</p> <p><i>Activity 2.3</i> Engage policy stakeholders</p>	<p>Working group established with a mandate to promote Fundisa for Change programme objectives at national level in relevant policy forums. Advocacy Strategy Developed for Fundisa for Change programme</p> <p>Fundisa for Change programme objectives are integrated into the policy agenda's and actions of key policy forums and relevant new policy processes.</p>
<p>OBJECTIVE 3: BUILD A NATIONAL SYSTEM OF ENGAGEMENT FOR ENVIRONMENTAL LEARNING AND TEACHER EDUCATION</p>	<p>Network expanded to include 75% of teacher education institutions and national</p>

<p><i>Activity 3.1</i> Host an annual conference for teacher educators for knowledge sharing, critical review and evaluation</p> <p><i>Activity 3.2</i> Actively involve more partners from institutions of higher learning</p> <p><i>Activity 3.3</i> Build a strong networking infrastructure</p> <p><i>Activity 3.4</i> Encourage the emergence of other ‘hubs’ or ‘nodes’ of excellence with capacity to offer the Fundisa for Change Programme/s</p>	<p>environmental partners involved in teacher education activities Teacher Educators are contributing to the development of the Fundisa for Change materials and the training of teachers.</p> <p>Fundisa for Change materials and programmes are incorporated into Education Faculty Teacher Education courses in higher education institutions (in at least 50% of HE institutions offering Teacher Education).</p> <p>Increased expertise and capacity for developing and expanding Fundisa for Change vision and activities exists.</p> <p>Hubs’ or ‘nodes of excellence’ with an interest in expanding co-ordination capacity for the Fundisa for Change programme/s are identified.</p>
<p>OBJECTIVE 4: STRENGTHEN CURRICULUM AND TEACHING SUPPORT MATERIALS, ESPECIALLY TEXTBOOKS:</p> <p><i>Activity 4.1</i> Strengthen the quality, progression and validity of existing curriculum knowledge through critical review, research and ongoing analysis</p> <p><i>Activity 4.2</i> Deepen analysis of environmental content knowledge currently represented in the national curriculum system</p> <p><i>Activity 4.3</i> Engage with textbook authors and curriculum designers to improve the quality, progression and validity of environmental curriculum knowledge and its representation.</p>	<p>Research report and recommendations produced (in the form of a ‘Policy Dialogue’ document / series of ‘Policy Dialogue documents’) on the quality, progression and validity of existing curriculum knowledge, including representation in textbooks.</p> <p>Informed policy dialogue and integration of results into national curriculum system and textbook revision systems.</p>
<p>OBJECTIVE 5: PROVIDE CO-ORDINATION SUPPORT TO ESTABLISH THE FUNDISA FOR CHANGE PARTNERSHIP PROGRAMME</p> <p><i>Activity 5.1</i> Establish and maintain a programme wide M&E system</p>	<p>Co-ordinator is appointed and placed at a Centre with the capacity to support the</p>

<p><i>Activity 5.2</i> Appoint and maintain a Fundisa for Change Co-ordinator, and office with staff and high level advisory team</p> <p><i>Activity 5.3</i> Develop and use appropriate marketing and communications tools</p>	<p>establishment of the Fundisa for Change programme.</p> <p>Monitoring and evaluation tools and system of implementation exists for use in all Fundisa for Change programmes.</p> <p>The Fundisa for Change programme is known and recognised by major stakeholders.</p>
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(Source: IP, pp. 8-9)

Appendix R: Mpumalanga Biodiversity teacher training workshop programme



PROGRAMME FOR MPUMALANGA TRAINING OF TEACHERS

JULY 09TH - 12TH - 2013

Day 1: 9th July TIME	ACTIVITIES	RESOURCES	RESPONSIBLE PERSON
8h30 - 9h15	Registration – start up of evaluation questionnaire (anyone arriving starts to complete part one of evaluation forms to establish a baseline)	Registers / Start up questions for evaluation	
9h15 – 10h00	Welcome – Introductions – Orientation into the fundisa programme and manuals – Questions and Clarification (teachers make a symbol which they think represents their family and the types of ideas they believe in – must be either a plant or an animal etc. Use this to introduce themselves – given some plastecene or they could be asked to draw or cut out or write)	Plastecene/ coloured Paper/ Scissors Pre-course Task Worksheets	
10h00 – 10h15	Tea		
10h15 - 11h30	Exploring biodiversity in the CAPS documents with an analysis of linkages between content topics and assessment requirements and identifying the assessment requirements for CAPS linked to this content	CAPS documents for Life Sciences and Natural Sciences (Intermediate and Senior Phase) Worksheet – linkages and instructions	

11h30 – 12h30	What is Biodiversity? The State of South African Biodiversity?	Presentation + magazines SANBI books Reading on Changing knowledge in Biodiversity	
12h30 – 13h30	Lunch		
13h30 – 15h00	Taxonomy	List of Plants and animals in the Gardens in Nelspruit Worksheet + Books	
15h00 - 15h30	Tea		
15h30 – 16h30	Exploring frameworks for improving teaching practice in working with CAPS – (initial presentation on framework and then a Discussions on how to teach any part of the framework- Choose one part of R's framework and they must then unpack it with an example of how they could teach using this framework)	R's Framework Methods Book	
16h30 - 17h00	Work away task – handing out of task- clarifying etc	Printed Copy of the research task – identify the content from 2 textbooks and one other resource	
17h00 – 17h30	Reflection/ Review	Reflection questions	
Day 2: 10th July TIME	ACTIVITIES	RESOURCES	RESPONSIBLE PERSON
8h00 - 9h00	Travel to Botanical Garden – 30 minutes Welcome and Review and presentation of work away task		
9H00 - 10H00	Exploring Biomes in South Africa (local Biome + terrestrial ecosystem)	Maps of Biomes – SANBI examples of activity	
10h00 – 10h30	Tea		
10h30 - 11h30	Linking Assessment Practices and Teaching Practice – through	Fieldwork in local environment SANBI example - reflecting back	

	Fieldwork – exploring local Biomes	against examples provided in exemplar.	
11h30 – 12h30	Discussion on the teaching practice approach used. (teachers first explain how they are teaching the section and what they are doing – highlighting challenges and successes they may be experiencing in this task) Identify the assessment task linked to fieldwork. Look at structure of the questions according to Blooms Taxonomy – weighting etc...Think about what is core for the understanding of this section for a student – look at what a good fieldwork task should have).	Methods book + Blooms Taxonomy Examples of assessment fieldwork task.	
12h30 – 14h00	Travel back and lunch		
14h00 – 15h00	Exploring Assessments linked to fieldwork – reflecting back against framework – linking assessment and teaching -	Fieldwork task – two examples – own examples and one other example	
15h00 - 15h30	Tea		
15h30 – 16h30	Ecosystem Services – Broad Overview and discussion on these concepts with practical examples		
16h30 - 17h00	Explanation of assignment – timeframes etc...		
17h00 – 17h30	Reflection/ Review/ work away task – thought on evaluation		
Day 3: 11th July TIME	ACTIVITIES	RESOURCES	RESPONSIBLE PERSON
8h00 - 8h30	Report back on work away task		

8H30 - 9h30	Ecosystem services – Exploring a practical example		
9h30 – 10h30	Exploring Biodiversity Loss and Impacts through case study approach		
10h30 - 10h45	Tea		
10h45 – 12h30	Using a case study as a teaching approach and an assessment task. Designing some questions linked to an appropriate case study example e.g. Rhino poaching / culling of elephants/ invasive alien species/ climate change examples		
12h30 – 13h30	Lunch		
13h30 – 15h30	Exploring responses – Policy and Local and personal responses		
15h30 - 16h00	Tea		
16h00 - 17h00	Identifying an appropriate planning framework and planning a lesson to teach -		
17h00 - 17h30	Conclusion – Way forward		
Day 4: 12th July TIME	ACTIVITIES	RESOURCES	PERSON RESPONSIBLE
8h00 - 8h30	Report back on work away task		
8h30 - 9h30	Presentation on away task		
9h30 – 10h30	Presentation on away task – Discussion		
10h30 - 10h45	Tea		
10h45 – 12h30	Key emerging ideas on Lesson plan design		
12h30 – 13h30	Explanation of assessment tasks		
13h30	Lunch and Travel		

Appendix S: Eastern Cape Biodiversity teacher training workshop programme



JULY 12TH - 14TH - 2013

Day 1: 12 July Time	ACTIVITIES	RESOURCES	RESPONSIBLE PERSON
8H30-9H00	Welcoming, introductions, tea, registration	Registration forms	All
9H30-10H30	Fundisa for Change overview, pre-course task, pre-evaluation questionnaire	Pre-course task, pre-evaluation questionnaire	Z
10H30-10H40	Short break		
10H40-13H00	Assessment, on-course task, assignment - Exploring biodiversity in the CAPS documents with an analysis of linkages between content topics and assessment requirements and identifying the assessment requirements for CAPS linked to this content	Fundisa for Change file, CAPS documents for Life Sciences	N
13H00-14H00 Lunch and check in			
14H00-14h30	On-course task feedback	Fundisa for Change file	N
14H30-15H00	Discuss pre-evaluation questionnaire	Pre-evaluation questionnaire	Z
15H00-16H30	Introduce unit, content	Fundisa for Change file	Z, S, K, N
16H30-17H00	On-course task (<i>progression</i>)	Fundisa for Change file	Z
17H00-17H30	Feedback to on -course task	Fundisa for Change file	Z
17H30	Wrap up and homework (<i>comparative analysis</i>)	Fundisa for Change file, teacher textbooks, magazines, SANBI book	N

Day 2: 13 July Time	ACTIVITY	RESOURCES	RESPONSIBLE PERSON
8H00-8H30	Reflection on day 1		K
8H30-9H00	Feedback on homework	File and resources i.e. SANBI book, articles,	N
9H00-10H30	Exploring frameworks for improving teaching practice in working with CAPS	R's framework,	R
10H30-11H00 TEA			
11H00-13H00	Introduce teaching methods book	Teaching methods book/ Fundisa for Change file	N and S
13H00-14H00 LUNCH			
14H00-15H00	Visit an ecosystem (the ocean?)- studying an ecosystem	Fundisa for Change file	K
15H00-15H30	Reflect on ecosystem visit and lesson plan on fieldwork	Fundisa for Change file	K & N
15H30-16H00	Tea		
16H00-17H30	Introduce ecosystem services, role of biodiversity, loss and impacts of biodiversity, responses	Fundisa for Change file	Z
17H00	Homework – planning a lesson	Fundisa for Change file	S
Day 3- 14 July Time	ACTIVITY	RESOURCES	RESPONSIBLE PERSON
8H00-8H30	Reflection of day 2	Fundisa for Change file	K
8H30-10H30	Presentation on the lesson plan homework	Lesson plans, Fundisa for Change file	S
10H30	Tea		
11H00-12H30	Discussion of assignment, next session, way forward		N
12H00-13H00	Wrap up and evaluation of training	Evaluation forms	Z
13H00	Lunch and travel		