A CASE STUDY OF EMERGENT ENVIRONMENTAL PEDAGOGICAL CONTENT KNOWLEDGE IN A FUNDISA FOR CHANGE TEACHER PROFESSIONAL DEVELOPMENT COURSE

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Abstract

This study set out to explore and describe in the form of a qualitative case study, an iteration of a *Fundisa for Change* teacher professional development programme, in this case the *Teaching Life & Living* short course presented to seventeen teachers as part of their Advanced Certificate in Teaching (ACT) Senior Phase Natural Sciences, at the University of Cape Town. The focus of the research was on describing how the development of teacher environmental pedagogical content knowledge (PCK) was supported and constructed in the course. The Consensus Model of Teacher Professional Knowledge and Skill, an outcome of the 2012 PCK Summit, was used to define the concept of PCK and also contributed the concept of amplifiers and filters as processes that mediate the development of teacher PCK. The study drew on Borko's (2004) model of a professional development system, using the elements of course, teachers, facilitators and context as an analytical framework. Data generated included a teacher contextual profile questionnaire, audio-recordings of group work, course outputs and reflection and evaluation forms. Data analysis had two phases: the first phase concentrated on the development of analytic memos based on particular data sources whereas the second phase worked across data sources to present the evidence relating to each of the professional development system elements. The study found that teachers were supported in the development of their environmental PCK by the collaborative learning opportunities afforded by the course. Emergent PCK was organised according to five components: assessment knowledge; pedagogical knowledge; content knowledge; knowledge of learners; and, curricular knowledge. Emergent teacher learning ranged in specificity from general, to subject-specific, to domain-specific, and lastly to topic-specific knowledge. Teacher beliefs and orientations, prior knowledge and contexts brought into the professional development system were described as amplifiers and filters to teacher learning of PCK. In particular there were several contextual factors that emerged as themes from the data that had

potentially filtering effects. Recommendations included that facilitators create an atmosphere conducive to collaborative learning, that evidence of learner conceptual understanding be examined during the course, that teachers be exposed to in-depth examples of canonical PCK and that more modelling of formative assessment strategies are presented.

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List of acronyms

ACT	Advanced Certificate in Teaching
CAPS	Curriculum and Assessment Policy Statement
CK	Content Knowledge
CoRe	Content Represenation
EE	Environmental Education
KEAG	Kommetjie Environmental Awareness Group
NCS	National Curriculum Statement
NEEP	National Environmental Education Programme
NRF	National Research Foundation
OECD	Organisation for Economic Co-operation and Development
PCK	Pedagogical Content Knowledge
PCK&S	Pedagogical Content Knowledge and Skill
PD-PCK	Professional Development Pedagogical Content Knowledge
PSP	Primary Science Project
RSA	Republic of South Africa
SACE	South African Council for Educators
SDU	Schools Development Unit
SMK	Subject Matter Knowledge
TALIS	Teaching and Learning International Survey
TBI	Teacher Belief Interview
TPD	Teacher Professional Development
TPKB	Teacher Professional Knowledge Base
TSPCK	Topic-Specific Pedagogical Content Knowledge
TSPK	Topic-Specific Professional Knowledge
UCT	University of Cape Town
WCED	Western Cape Education Department

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Chapter 1 Context and research questions

1.1 Introduction

This chapter provides the rationale for the study and places it within a national context. A brief policy history of the South African curriculum changes and teacher professional development over the last two decades is given, including the implications of these policies for environmental education in teacher professional development. The research goals and questions for the study are described, as well as the overall structure of the thesis.

1.2 National context

In South Africa, from 2011 to 2014, the amended National Curriculum Statement Grades R-12 (NCS), now called the National Curriculum and Assessment Policy Statements Grades R-12 (CAPS), was implemented for each subject. A 2009 curriculum review had called for a more strongly content-referenced curriculum and also recommended that "where appropriate teachers should be given guidance and support in the documents on how to teach specific content, concepts and skills, particularly in areas of difficulty" and that "clarity on the appropriateness of certain methodologies … should be provided" (Dada, F., Dipholo,T., Hoadley, U., Khembo, E., Muller, S. &Volmink, J., 2009, p. 27). This interest in 'how to teach' to specific subject needs and in looking critically at particular methodologies, pointed to the need for developing teaching and assessment strategies for working with specific content and skills, and is central to an emergent interest in South African teacher professional development in pedagogical content knowledge (PCK).

Since 1997, there had been an environmental emphasis in the NCS in the form of principles that reflected the environment clause in the Bill of Rights in the Constitution of the Republic of South Africa (South Africa, 1996), specifically the principle of "human rights, inclusivity, environmental and social justice" (South Africa. Department of Basic Education [DBE], 2011, p. 5). In 2000, the National Environmental Education Programme was initiated with one of its aims being to support the implementation of this principle (Lotz-Sisitka, 2011). In 2011, the South African curriculum changed to the Curriculum and Assessment Policy Statements (CAPS) for specific subjects. Of particular interest within environmental

education teacher professional development, was the new environmental content found in the CAPS. This new content included biodiversity, climate change, water security, sustainable development and environmental health (Fundisa for Change Programme, 2013). Together, environmental topics account for up to 50 per cent of the CAPS curriculum for some subjects (Lotz-Sisitka, 2011, p. 31). Consequently, the CAPS curriculum changes led to a gap in teacher knowledge, prompting the formation of the *Fundisa for Change* programme as a national response to the challenge of environmental education teacher professional development.

The *Fundisa for Change* programme was formed by a national South African network of teacher education institutions with an interest in developing environmental education in the country. Developing teacher capacity through environmental education teacher professional development courses is one of the key objectives of this programme which aims "to build a national system of engagement to broaden and deepen capacity for environment and sustainability education in South African schools" (Rosenberg & Lotz-Sisitka, 2013, p. 2). In the programme, teacher environmental education capacity-building is achieved through improving knowledge of environmental content, teaching practice, and assessment practice of teachers (Fundisa for Change Programme, 2013, p. 2). This three-fold focus also met the demand, highlighted in the policy response to the challenges of continuing professional development, that courses need to "emphasise the integrated development of learning area or subject content knowledge and pedagogical skills" (South Africa. Department of Education [DoE], 2006, p. 20).

The National Policy Framework for Teacher Education and Development in South Africa (2006) describes continuing teacher professional training and development as having the following conceptual and pedagogic needs:

> 45. Both conceptual and content knowledge and pedagogical knowledge are necessary for effective teaching, together with the teacher's willingness and ability to reflect on practice and learn from the learners' own experience of being taught. These attributes need to be integrated, so that teachers can confidently apply conceptual knowledge-in-practice.
> 46. It is clear that all teachers need to enhance their skills, not necessarily qualifications, for the delivery of the new curriculum. A large majority need to strengthen their subject knowledge base, pedagogical content knowledge and teaching skills.
>
> (South Africa. DoE, 2006, p. 16-17)

However, despite these needs identified in the National Policy Framework in 2006, in the Environmental Sector Skills Plan for South Africa (South Africa. Department of Environmental Affairs [DEA], 2010) it was noted four years later that "inadequate attention has been given to teachers' competence and pedagogical content knowledge to introduce new areas of learning (e.g. knowledge of environmental change/global change; biodiversity; sustainable development, etc.) into teaching" (p. 26). This was followed by a recommendation for teacher education that was taken up in the Human Capital Development Strategy (South Africa. Department of Environmental Affairs [DEA], 2011). Once again, the identified area of teacher knowledge in need of support was that of pedagogical content knowledge and knowledge of the new environmental content that had been included in the curriculum. These knowledges are essential as teachers form the front line for the integration of environmental learning into the classroom.

The *Fundisa for Change* programme responded to the aforementioned challenges by including the following in their teacher education material:

> a) "Generic orientation to key issues such as knowledge, curriculum knowledge, environment and sustainability knowledge, pedagogical content knowledge and approaches and assessment practice.
> b) Specific environment and sustainability content knowledge, pedagogical content knowledge and assessment practice as relevant to specific subjects and phases and grades in the South African school system.
> c) It is closely aligned and integrated with the CAPS curriculum framework and imperatives.
> d) The materials and CPD framework are designed to articulate with, and to allow teachers to reflect on textbooks and their contents and use in classrooms. The materials are also designed to provide teachers with access to additional learning support materials that can support classroom practice."
>
> (Fundisa for Change Programme, 2014, p. 1)

In including these topics and focus areas in their course materials and guidelines, the programme identified and responded to the need for environmental pedagogical content knowledge. More explicitly, "pedagogical content knowledge and quality assessment practice" (Lotz-Sisitka, 2011, p. 68) is listed as a course orientation, with the course guideline document stating that it "provides direct support to teachers to develop their pedagogical content knowledge, as required by the different subjects and the different disciplines" (Lotz-Sisitka, 2011, p. 68). As observed in the *Fundisa for Change Introductory Core Text*, "it is important to 'know your subject' well, and particularly the environmental content embedded

in your subject. Knowledge on its own, however, is not enough, and the creative teacher uses a wide range of methods to mediate learning" (Fundisa for Change Programme, 2013, p. 0).

Another feature of the *Fundisa for Change* course is the participatory method of delivery. In the *Guidelines for Facilitation of the Fundisa for Change Teacher Education Programmes* document, the programme is described as "a carefully designed, facilitator led, inter-active professional development programme that has a strong structure, but with opportunities for teacher participation, practical and reflective engagement with concepts, approaches and ideas, informed by TPD [Teacher Professional Development] research and best practices" (Fundisa for Change Programme, 2014, p. 1).

1.3 Focus and Rationale

Having written teacher training material for two of the *Fundisa for Change* courses and having facilitated *Fundisa for Change* courses as well, I was curious to investigate teacher learning within the professional development context. This research has provided me with an opportunity to do so. It is against the national context described above that this case study endeavours to understand how environmental PCK is supported and constructed in the *Fundisa for Change* teacher professional development courses and to describe the emergent environmental PCK of the teacher-participants. In the Lotz-Sisitka (2011) report on the development and piloting of the *Fundisa for Change* courses, it was noted that "the depth, contextualisation and expansion of teachers' subject knowledge and pedagogical content knowledge appeared to be critical issues" (p. 46) causing a revision of the conceptual framework for the courses to focus more clearly on subject knowledge and pedagogical content knowledge (Lotz-Sisitka, 2011). The *Fundisa for Change* programme also produced teacher education material to develop essential knowledge, PCK and assessment practices (Lotz-Sisitka, 2011) that consisted of an *Introductory Core Text* with broad relevance as well as topic-specific booklets. PCK and quality assessment practice were listed as course orientations with both foundational and subject-specific PCK mentioned (Lotz-Sisitka, 2011). These aims and orientations gave a sense of what was supposed to happen in a *Fundisa for Change* course. However, the finer detail of what and how this was happening through the enactment of the course was not apparent. More specifically, the questions that arose

concerned what environmental PCK learning was emerging from the course and how the development of PCK was being supported by the course.

This descriptive case study can be described as instrumental as it aims to "present a particular situation but is intended to inform other situations or cases" (Yin, 2011, p. 18). Thus the case study, by describing a particular *Fundisa for Change* course, could be used to inform the implementation of future iterations of the *Fundisa for Change* course or other environmental education programmes wanting to focus on environmental pedagogical content knowledge. Through the description of a particular enactment of the course, including the course activities and the contextual influences, the study aims to contribute to a "history of practice" (Shulman, 1987, p. 12) of the teaching of the *Fundisa for Change* courses. A detailed and rich description of an iteration of the course could be a useful resource for 'Train the Trainer' course developers and/or the new trainers as the *Fundisa for Change* programme takes its next steps towards upscaling.

The study required access to a group of practicing teachers who were prepared to complete a short in-service environment-focused teacher professional development course. I was offered the opportunity to co-facilitate with Nomvuyo Mgoqi, the *Fundisa for Change Teaching Life & Living* course to seventeen teachers completing a two-year part-time Advanced Certificate in Teaching (ACT) Senior Phase Natural Sciences in-service training course. The ACT was run by the Schools Development Unit, part of the School of Education at the University of Cape Town (UCT) and convened by Nomvuyo Mgoqi, a Science Specialist in the Schools Development Unit. The *Fundisa for Change* course was started as the introduction to the teachers' '*Life & Living*' lecture block in the first semester of their second year of the ACT. '*Life & Living*' is one of the four knowledge strands making up the Natural Sciences curriculum.

1.4 Research questions and design overview

The study describes a *Fundisa for Change* environmental education professional development course through the lens of PCK as it seeks to answer the research question: 'How is the development and emergence of environmental PCK supported and constructed in the *Fundisa for Change* teacher professional development course?'

This main question was supported by two sub-questions:

- Sub-Question 1: What are the elements and relationships between them in the *Fundisa for Change* teacher professional development system?

This sub-question constituted the contextual work underpinning the broader research question. Data sources included: teacher contextual profile questionnaires; *Fundisa for Change* teacher professional development course materials; and, video- and audio-recordings of the course enactment. Together these were used to build up a comprehensive contextual picture.

- Sub-Question 2: What are the amplifiers and filters affecting the development of teacher PCK in the *Fundisa for Change* teacher professional development system?

Key to answering this sub-question was an understanding of the impact of teachers' beliefs, context and prior knowledge as potential amplifiers and filters to teacher learning during the course. Data sources were: teacher contextual profile questionnaires; *Fundisa for Change* teacher professional development course outputs; transcripts of the audio-recordings of groups of teachers; and, the reflection and evaluation forms.

The *Fundisa for Change* teacher professional development programme was described by drawing on Borko's (2004) model of a professional development system as an analytic framework. Borko's (2004) model identifies four elements: course, facilitators, teachers and context. Analysis allowed for elements and their interactions to be examined. In addition filters and amplifiers to teacher PCK learning were identified. The Consensus Model of teacher professional knowledge and skill (Gess-Newsome, 2015, p. 31) was used to define PCK. Emergent PCK was investigated using the theoretical framework of the teacher professional knowledge bases presented in the Consensus Model. These consisted of the five components: assessment knowledge; pedagogical knowledge; content knowledge; knowledge of learners; and, curricular knowledge.

1.5 Thesis structure

The thesis consists of six chapters. Chapter 1 provides the background and context to the study. Chapter 2 presents in the form of a literature review, the main constructs and concepts involved in the study including pedagogical content knowledge, environmental pedagogical content knowledge, and teacher professional development as a system. Chapter 3 focuses on presenting and substantiating the research design and ethics choices. The data generation methods and analytic tools are presented and data analysis procedures are described. The analysis of the data is presented in Chapter 4, with a discussion of findings and their relevance to the research questions being the focus of Chapter 5. Conclusions and recommendations are in Chapter 6.

Chapter 2 Literature review

2.1 Introduction

The core literature reviewed for this chapter considers the development of teacher personal pedagogical content knowledge (PCK) within professional development programmes. The chapter starts by presenting a definition of teacher PCK, locating it within the spectrum of professional knowledge. This is followed by an exploration of the influence of amplifiers and filters on the development of PCK. The knowledge components of PCK along with an explanation of the processes of pedagogical reasoning and reflection that would lead to teacher construction of PCK are discussed next. Finally, the elements of a professional development system and the relationships between them are identified and discussed in terms of their potential impacts on teacher PCK growth.

2.2 Pedagogical content knowledge and teacher professional knowledge

The framework underpinning the contextual work in this study is informed by a strong international interest in PCK research that has grown from Lee Shulman's conceptualisation of the notion in the mid-1980s. In October 2012, a PCK Summit was held in Colorado Springs, USA. Twenty-five researchers from seven countries (including South Africa) attended the conference, representing teams of people who were working on PCK research. The aim was to work collaboratively towards consensus on the definitions, terminology and assessment of the concept of PCK, as well as to guide future research. It was felt that a new research focus was necessary, as understanding of the concept had become divergent (Carlson, Stokes, Helms, Gess-Newsome, & Gardner, 2015, p. 14).

The summit was opened by Shulman, who in his 1986 book described PCK as including both the "ways of representing and formulating the subject that make it comprehensible to others" (Shulman, 1986, p. 9) and the strategies that will allow for a reconstruction of "conceptions and preconceptions" (Shulman, 1986, p. 9) brought to the learning situation. PCK thus includes teachers' knowledge of how to integrate planning for instruction, content and classroom delivery. Acknowledging the work done by researchers since his original conception of the idea, Shulman said that he felt "like the biological father of a baby that was

raised in its infancy and then given away for adoption or foster care when it was about five years old" (Shulman, 2015, p. 3).

In his opening address, Shulman identified four limitations to his original conceptualisation of PCK that he felt the summit should attempt to address: Lack of recognition of affective, emotional and motivational aspects of teaching; over emphasis on teacher thinking at the expense of a focus on pedagogical action; lack of attention to the culture and context within which teaching and learning was taking place; and, not enough attention to resultant learner outcomes of teaching (Shulman, 2015, pp. 9-10). Mindful of addressing these limitations, two of the outputs from the summit were a new definition of PCK and what has become known as the Summit Consensus model of teacher professional knowledge and skill. These two outputs will now be discussed in turn.

2.2.1 Defining pedagogical content knowledge

In the definition that emerged from the PCK Summit, PCK is portrayed as personal or private professional knowledge held by an individual and which relates directly to classroom practice. In this sense, the PCK of one teacher would not be the same as the PCK of another teacher. Classroom practice is divided into two parts: The planning for teaching and the skill involved in the act of teaching. It is described as the space in which personal PCK interacts with the classroom context. At the summit, PCK and the construct PCK and Skill (PCK&S) were defined as follows:

> - Personal PCK is the *knowledge* of, *reasoning* behind, and *planning* for teaching a particular *topic* in a particular *way* for a particular *purpose* to particular *students* for enhanced *student outcomes* (Reflection *on* Action, Explicit).
> - Personal PCK&S is the *act of teaching* a particular *topic* in a particular *way* for a particular *purpose* to particular *students* for enhanced *student outcomes* (Reflection *in* Action, Tacit or Explicit).
>
> (Gess-Newsome, 2015, p. 36)

The definitions have allowed for the separating out of knowledge used for teaching and the skill involved in the enactment of teaching as teachers apply this knowledge within their classroom context. The definitions also refer to the use of PCK at different times – the first in the *planning for* teaching and the second in the *act of teaching*. In planning for teaching, PCK is applied in the form of reflecting *on* action (Schön, 1983) during which knowledge of

teaching a particular topic and the reasoning behind choices made as to how to teach it, are brought together from past experiences (Park & Oliver, 2008). Personal PCK can thus be made explicit through the planning process. The act of teaching requires personal PCK&S and tends to be far more tacit as teachers think-on-their-feet and make decisions in split-seconds, the 'why' of which are very hard to capture after the fact (Gess-Newsome, 2015, pp. 36-37). Thus, this new definition with its two parts attempts to resolve one of Shulman's comments about PCK, by drawing attention to pedagogical action as well as pedagogical reasoning. The focus in this study is on the first part of the model's PCK definition: looking at teachers' reasoning behind and planning for teaching and the potential, within the *Fundisa for Change* course, for development of personal environmental PCK. How this personal PCK is subsequently enacted in classroom practice as well as learner outcomes are outside the scope of the present study.

2.2.2 The relationship between PCK and teacher professional knowledge

Another result of the PCK summit was the development of the Summit Consensus model of teacher professional knowledge and skill, a section of which is shown in Figure 2.1 below. This model is used to clarify and develop the conceptualisation of teachers' PCK in terms of its relationship to other teacher professional knowledges and, in the process, to address some of the issues raised by Shulman in 2012. Shulman (1986; 1987) had argued that teacher professional knowledge takes a variety of forms. He identified the following seven knowledge bases that together would form the basis of teacher professional knowledge:

> — content knowledge;
> — general pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter;
> — curriculum knowledge, with particular grasp of the materials and programs that serve as "tools of the trade" for teachers;
> — pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding;
> — knowledge of learners and their characteristics;
> — knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; and
> — knowledge of educational ends, purposes, and values, and their philosophical and historical grounds.
>
> (Shulman, 1987, p. 8)

In defining the professional knowledge of teachers, the last century has seen a move away from content knowledge (CK) as the predominant feature, to now include what Shulman (1986) referred to as "the missing paradigm" (p. 7), pedagogical content knowledge. The relationship between teachers' PCK and their CK has been the focus of much research, indicating a positive correlation between the two. Daehler, Heller and Wong (2015) in their research into this relationship found that "teacher CK is necessary for developing PCK, but is not sufficient on its own; teachers' own CK is inextricably interrelated with their knowledge about how to teach that content; and weak content knowledge inhibits teachers' engagement in PCK-rich discussions" (p. 52). Rollnick (2016) similarly found in her research on the role of CK in PCK development among teachers learning a new topic that "the development of content knowledge was combined with increased understanding of how to teach the topic in almost all cases" (p. 1). The Summit Consensus model suggests a more complex relationship between not only PCK and CK, but the other teacher professional knowledge bases as well.

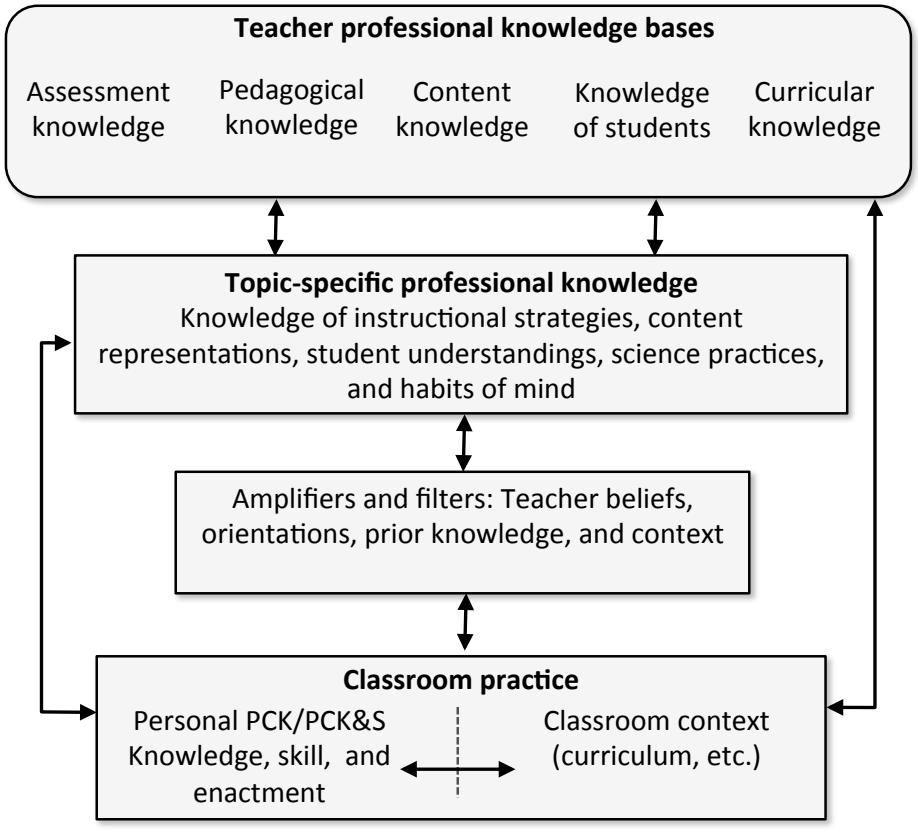

Figure 2.1 Selected section of the Summit Consensus Model of teacher professional knowledge and skill (Gess-Newsome, 2015, p. 31)

According to Gess-Newsome (2015) the first two levels of the Summit Consensus model represent canonical professional knowledge (generalised and topic-specific respectively) in that they consist of "a formal body of knowledge determined and codified by researchers" (p. 32) having "a normative function" (p. 33). The first level of the Summit Consensus model - the teacher professional knowledge bases - included four of Shulman's (1987) knowledge bases and, along with assessment knowledge, collectively represent generalised, canonical teacher professional knowledge.

As you may have noted, pedagogical content knowledge, originally conceptualised by Shulman as one of the seven teacher knowledge bases and defined by him as representing "the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction" (Shulman, 1987, p. 8), is not considered part of canonical knowledge in the Summit Consensus model. Rather it is defined as personal, context-specific knowledge held by the teacher (Gess-Newsome, 2015, p. 36). The personalisation of PCK is explained in more detail in Section 2.3 below.

In the second level of the model, separated out from the generic knowledge bases, but shown as informed by and informing them, are the knowledges that can be applied to the teaching of a particular topic to a specific grade level. This topic-specific professional knowledge (TSPK) serves several new purposes:

> (1) It makes explicit that content for teaching occurs at the topic level (i.e., force and motion) and not at the disciplinary level (i.e., physics or science);
> (2) This knowledge blends subject matter, pedagogy, and context; and,
> (3) It is recognized as public knowledge, or knowledge held by the profession, allowing it to assume a normative role.
>
> (Gess-Newsome, 2015, p. 30)

Gess-Newsome (2015) describes how in planning to teach a topic, the interaction between the teacher and professional knowledge can enable growth of both the generic teacher professional knowledge bases and the topic-specific professional knowledge: On the one hand, a teacher moves from an understanding of the generic teacher professional knowledge bases to being able to give appropriate topic-specific examples; on the other hand, active reflection on specific examples can be used to develop and grow generic ideas (p. 34). As mentioned above, both teacher professional knowledge bases and topic-specific professional

knowledge are canonical knowledge held by the teaching community and it is from these knowledges that personal PCK and PCK&S emerge through specific people in specific circumstances.

Within the context of South African educational policy, the Minimum Requirements for Teacher Education Qualifications (South Africa. Department of Higher Education and Training [DHET], 2011) identifies five types of learning for teachers, namely:

- Disciplinary Learning
- Pedagogical Learning
- Situational Learning
- Practical Learning
- Fundamental Learning (p. 8)

The descriptions of the knowledge involved in the first three of the learning types listed above are inclusive of all seven of Shulman's knowledge bases: Disciplinary Learning, including both content knowledge in the form of "specialised subject matter" (South Africa. DHET, 2011, p. 8) and "the study of education and its foundations" (South Africa. DHET, 2011, p. 8) corresponds with Shulman's first and seventh knowledge bases; Pedagogical Learning, described as inclusive of "knowledge of learners, learning, curriculum and general instructional and assessment strategies" (South Africa. DHET, 2011, p. 8) as well as "specialised pedagogical content knowledge" (South Africa. DHET, 2011, p. 8), corresponds to Shulman's second, third, fourth and fifth knowledge bases; and, Situational Learning refers to "learning *about* context" (South Africa. DHET, 2011, p. 8) and corresponds to Shulman's sixth knowledge base. Specialised PCK is described in the Minimum Requirements for Teacher Education Qualifications document as "knowing how to represent the concepts, methods and rules of a discipline in order to create appropriate learning opportunities for diverse learners, as well as how to evaluate their progress" (South Africa. DHET, p. 8). This description correlates with the topic-specific professional knowledge conceptualisation in the second level of the Summit Consensus model. Pedagogical Learning together with Disciplinary Learning contain the canonical teacher professional knowledge bases of the first level of the Summit Consensus model.

Practical Learning is defined as "learning in and from practice" (South Africa. DHET, 2011, p. 8). The development of knowledge based on Practical Learning, while not listed by

Shulman (1987) as a knowledge base, is referred to by him as "Wisdom of practice" (p. 11) and proposed as one of the "four major sources of the teaching knowledge base" (p. 8). Gess-Newsome (2015) explains that personal knowledge developed by reflection on teaching practice, "can contribute to and grow the public and professional knowledge bases" (p. 38) as teachers relate their experiences to the professional knowledge. These effects are shown in the Summit Consensus model by the arrows linking the Classroom Practice level to the professional knowledge levels.

The last of the types of learning described in the Minimum Requirements for Teacher Education Qualifications (South Africa. DHET, 2011) is Fundamental Learning. This includes "learning to converse competently in a second official language, the ability to use Information and Communication Technologies (ICTs) competently, and the acquisition of academic literacies" (South Africa. DHET, 2011, pp. 8-9). Knowledge in these areas has been identified as important for all teachers within the South African context and therefore separated out from Disciplinary Learning and expected to be integrated across all learning.

2.3 Amplifiers and filters

Consideration of specific people in specific circumstances is captured in the Summit Consensus model through the inclusion of the filtering or amplifying powers of teacher beliefs, orientations, prior knowledge and context. These filters and amplifiers affect teacher personal PCK and PCK&S as well as their classroom practice (Luft & Roehrig, 2007; Opfer & Pedder, 2011; Gess-Newsome, 2015). The inclusion of teacher beliefs, attitudes and orientations provided a way to give recognition to the affective, emotional and motivational aspects of teaching, thereby addressing another of Shulman's concerns.

The existence of amplifiers and filters in the Summit Consensus model provides a means of understanding why the PCK of individual teachers can be variable despite the same input from teacher training and professional development programmes. The implication is that amplifiers and filters cause teachers to 'pick and choose' from knowledge presented during professional development programmes, according to their perceived context, instructional orientation, learners, beliefs, et cetera, as they evaluate the new information. This separating out of teacher beliefs, orientations, prior knowledge and context from the concept of PCK,

and showing how they can act as a lens through which a teacher selects knowledge and actions for the classroom, is a main difference between this model and previous models where these were included as components of PCK. PCK is thus professional knowledge that has "passed through the lens of the teacher" (Gess-Newsome, 2015, p. 34) becoming personalised and contextualised as it is influenced by the teachers beliefs, orientations, prior knowledge and context, all of which may act to filter or amplify the learning of new knowledge.

2.3.1 Teacher beliefs and orientations as amplifying or filtering knowledge

The role of teacher beliefs about classroom practice has been a focus of much research. Researchers have defined beliefs in a variety of ways. In this study, they are defined as "personal constructs that are important to a teacher's practice, as they guide instructional decisions, influence classroom management, and impact the representation of the content" (Luft, Firestone, Wong, Ortega, Adams, & Bang, 2011, p. 1202). This definition is also drawn on by Mavhunga and Rollnick (2015) in their work relating science teacher beliefs to topic-specific PCK (TSPCK) in a South African context. They described their construct of TSPCK as aligned to the topic-specific professional knowledge of the Summit Consensus model (Rollnick & Mavhunga, 2015, p. 141). In their study, Mavhunga and Rollnick (2015) found that, as had been reported with PCK, "explicit development of TSPCK appears to influence in a significant way a shift of underlying teacher science beliefs towards responsive and reformed kinds of beliefs. These are beliefs associated with learner-centred classroom practices" (Mavhunga & Rollnick, 2015, p. 21). They did however, caution against oversimplifying the relationship as they also found that for a minority, traditional science education beliefs were evident in teachers with a developed TSPCK (Mavhunga & Rollnick, 2015, p. 22). Understanding teachers' beliefs and how these are connected to practice is important when considering the design of professional development activities (Luft & Roehrig, 2007, p. 49). Research has shown that teachers' beliefs are not static, but change over their careers, with pre-service and experienced teachers showing a greater tendency towards constructivist and reform-based beliefs in relation to teachers in their first few years of practice (Luft & Roehrig, 2007).

A belief may act as a filter or amplifier, with teachers either incorporating or rejecting ideas and experiences based on their compatibility with the existing views (Gess-Newsome, 2002;

Luft & Roehrig, 2007; Opfer & Pedder, 2011; Gess-Newsome, 2015). In this way beliefs "can guide instructional decisions, influence classroom management, and serve as a lens of understanding for classroom events" (Luft & Roehrig, 2007, p. 38). Although dissonance in teacher thinking is recognised as a motivator for change (Opfer & Pedder, 2011, p. 388), if the dissonance between beliefs and experience is too great, teachers may reject or filter out new learning (Opfer & Pedder, 2011, p. 389). An additional problem may be that, in adapting a new strategy for their specific context, teachers might also inadvertently lose or alter the main purpose of the strategy (van Driel, Meirink, van Veen, & Zwart, 2012, p. 130).

Orientations are not discussed separately from beliefs in this study but rather are viewed as interrelated sets of beliefs with the following dimensions: "beliefs about the goals and purposes of science teaching, beliefs about the nature of science, and beliefs about science teaching and learning" (Friedrichsen, van Driel, & Abell, 2011, p. 373). This definition was proposed by Friedrichsen et al. (2011) in order to overcome some of the issues surrounding the use of the orientations construct, namely, the lack of a clear definition or understanding of the way in which orientations interact with other PCK components (pp. 366-368).

2.3.2 Teacher prior knowledge as amplifying or filtering new knowledge

Teachers' prior knowledge is also proposed in the Summit Consensus model as having a filtering or amplifying affect in that "as teachers learn, new knowledge emerges from the interaction of the teacher learning systems, and this new knowledge then recursively influences future learning and also what is to be known about teaching" (Opfer & Pedder, 2011, p. 388). What teachers learn, therefore depends on what they have already learned and the depth of their knowledge (Opfer & Pedder, 2011; Gess-Newsome, 2015).

2.3.3 Context as amplifying or filtering knowledge

A third amplifier or filter in the Summit Consensus model is context. Contextual factors such as "access to high-quality professional development … as well as the nature of the professional development" (Gess-Newsome, 2015, p. 35) can impact on "what a teacher knows and how knowledge may or may not be used" (Gess-Newsome, 2015, p. 35). The model shows the influence of context on the teacher in two places: as amplifying or filtering teachers' knowledge, skill and enactment and as classroom context, included in the classroom

practice level in the Summit Consensus model. The inclusion of context in the model attempts to address another of Shulman's concerns, namely a lack of attention to the culture and context within which teaching and learning was taking place.

2.4 Levels and components of PCK

Mavhunga and Rollnick (2015) report in their review of PCK literature that there appear to be four different levels of PCK, ranging in specificity from general, to subject-specific, to domain-specific, and lastly to topic-specific PCK. General PCK refers to pedagogical concepts that "may be applied broadly across disciplines" (Mavhunga & Rollnick, 2015, p. 3) thus closely aligned to the generic teacher professional knowledge bases of the Summit consensus model. Subject-specific PCK would apply to PCK that is specifically for a particular subject, for example to "PCK abilities that are specific to science" (Mavhunga & Rollnick, 2015, p. 3). Domain-specific PCK refers to PCK for teaching the different branches or domains of a subject. For example, in the Natural Sciences subject at Senior Phase level, content is organised into four domains of knowledge, referred to as knowledge strands: Life and Living; Matter and Materials; Energy and Change; and, Planet Earth and Beyond (South Africa. DBE, 2011, p. 9). Each of these domains has "their own list of concepts, terms and topics" (Mavhunga & Rollnick, 2015, p. 3). Lastly, topic-specific PCK is described as "knowledge that enables transformation of content knowledge, topic by topic" (Mavhunga & Rollnick, 2015, p. 3) and is "in line with 'Topic-Specific Professional Knowledge'" Mavhunga & Rollnick, 2015, p. 4) from the Summit Consensus model (see Section 2.2.2).

In addition to the levels themselves, within these levels, researchers have included different components for PCK, as well as defining the components differently (Van Driel, Verloop, & de Vos, 1998; van Dijk & Kattmann, 2007). However, the components included mostly represent variations and combinations of Shulman's (1987) teacher professional knowledge bases (see Section 2.2.2). For the purposes of this study, the Summit Consensus model will be used. In this model, the teacher professional knowledge bases and the topic-specific knowledge derived from the bases, together provide the professional, canonical knowledge from which PCK is derived. The knowledge components of PCK will therefore be presented in terms of these professional knowledge bases. Each of the components are described below.

2.4.1 Assessment knowledge

Assessment knowledge is the first of the teacher professional knowledge bases in the Summit Consensus model. The assessment knowledge base is described as including "knowledge of the design and use of formative and summative assessments and how to use results from those assessments to design or modify instruction" (Gess-Newsome, 2015, p. 32). Summative assessment typically refers to the formal assessment undertaken at the end of a unit of learning while formative assessment can be defined as follows:

> Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited. (Black & Wiliam, 2009, p. 9).

At a topic-specific level, Smith and Banilower (2015) describe this component as inclusive of "knowledge of activities/ representations/ hypothetical scenarios that can be used to elicit and diagnose the thinking of students" (p. 90). Formative assessment strategies are thought to have the potential to "increase the rate of student learning by somewhere between 50 and 100 per cent" (Leahy & Wiliam, 2012, p. 51) and include:

- clarifying learning intentions and sharing criteria for success
- engineering effective classroom discussions, activities and tasks that elicit evidence of learning
- providing feedback that moves learners forward
- activating students as instructional resources for one another, and
- activating students as owners of their own learning (Leahy & Wiliam, 2012, p. 57)

2.4.2 Pedagogical knowledge

The pedagogical knowledge base may consist of "strategies for classroom management and student engagement, for example, questioning techniques, instructional strategies to support differentiation based on student need, or how to design a lesson plan" (Gess-Newsome, 2015, p. 32). At a topic-specific level, this means "determining effective instructional strategies" (Gess-Newsome, 2015, p. 32). For the purposes of this study, developing habits of mind involving problem-solving strategies and thinking and reasoning skills that encourage and assist learners in dealing with new information or scenarios (Park & Oliver, 2008, p. 276) are

included under teaching strategies. Also included are topic-specific content representations. These are "representations of content (models, examples, analogies) that are particularly effective in revealing the subtle aspects of a content area" (Smith & Banilower, 2015, p. 90).

2.4.3 Content knowledge

Gess-Newsome (2015) refers to the teacher professional knowledge base of content knowledge as "the academic content of the discipline" (p. 32) including the "practices used to generate knowledge, the disciplinary core ideas, and the recognition of cross-cutting concepts" (p. 32). At a topic-specific level, this means "organizing content to use specific examples to highlight and build overarching ideas" (Gess-Newsome, 2015, p. 32).
In the conceptualisation of the components of PCK used in this study, content knowledge has been included as a component of PCK. This inclusion has historically been a point of contention amongst researchers (Rollnick, 2016, p. 4) as some feel that content knowledge is a discrete knowledge base. Given the complex relationship between CK and PCK (see Section 2.2.2) however, I have included it as a component of PCK. In the Summit Consensus model, "CK appears as one of the teacher professional knowledge bases, and as such is an essential underpinning of TSPK" (Rollnick, 2016, p. 5).

2.4.4 Knowledge of learners

This knowledge base includes "student cognitive and physical development, understanding student differences that might require instructional differentiation, and how to capitalize on personal and community assets to enrich instruction" (Gess-Newsome, 2015, p. 32). At a topic-specific level, this includes "knowledge about what students know about a topic and areas of likely difficulty" (Park & Oliver, 2008, p. 266). In addition, Loughran, Berry and Mulhall (2012) argue that in the absence of a knowledge of learners "teaching is not genuinely responsive to constructivist views of learning and is therefore not concerned with students processing, structuring, synthesizing and reconstructing their knowledge, but more so with adding new "chunks" of learning onto existing knowledge regardless of their existing views/understanding of the content" (p. 18).

2.4.5 Curricular knowledge

This teacher professional knowledge base incorporates the "goals of a curriculum, curriculum structures, the role of a scope and sequence, and the ability to assess a curriculum for coherence and articulation" (Gess-Newsome, 2015, p. 32). At a topic-specific level, this means understanding how the topic relates to the curriculum as a whole and being able "to identify core concepts, modify activities, and eliminate aspects judged to be peripheral to the targeted conceptual understanding" (Park & Oliver, 2008, p. 266) as well as the "nature of science within a topic" (Gess-Newsome, 2015, p. 32).

2.5 The processes of pedagogical reasoning

The present study investigated the emergent personal PCK of teachers during a professional development programme and thus focused on capturing the processes of pedagogical reasoning and reflection during professional development activities. Shulman (1987) discusses "teaching as comprehension and reasoning, as transformation and reflection" (p. 13) and developed these ideas into "a model of pedagogical reasoning and action" (p. 15). Although the model is often represented as a cycle, Shulman (1987) stressed that the direction and sequences of the reasoning processes may differ (p. 14). His descriptions of the constituent processes of pedagogical reasoning associated them with particular knowledge bases (Shulman, 1987). Each of the processes are discussed in more detail below.

2.5.1 Comprehension

Shulman (1987) argues that comprehension in the form of active engagement with ideas, is the starting point of pedagogical reasoning. Not only do teachers need to understand the ideas, concepts and texts to be taught, but they also need to understand how they are relevant both across other subjects and within the same subject (Shulman, 1987, p. 14). At the same time, the teacher needs to be cognisant of the educational goals and purposes of the ideas (Shulman, 1987, p. 15). The process of comprehension is relevant to the study as it reaffirms the importance of the development of conceptual understanding of the content as a starting point in the *Fundisa for Change* courses (see Section 2.2.2).

2.5.2 Transformation

Transformation is described by Shulman as consisting of "some combination or ordering" (Shulman, 1987, p. 16) of the core processes of preparation, representation, selection, adaptation and tailoring "wherein one moves from personal comprehension to preparing for the comprehension of others" (Shulman, 1987, p. 16). The outcome of the transformation processes is a plan for the lesson. Each of the transformation processes are described in more detail below.

i) Preparation

This process refers to the critical interpretation of the teaching materials from the perspective of the teacher's understanding of the curriculum, instructional materials, concepts and educational goals and purposes. Shulman (1987) describes it as having two steps: "(1) detecting and correcting errors of omission and commission in the text, and (2) the crucial processes of structuring and segmenting the material into forms better adapted to the teacher's understanding and, in prospect, more suitable for teaching" (p. 16). This process includes knowledge of curriculum materials and is described as drawing upon "a curricular repertoire" (Shulman, 1987, p. 16).

ii) Representation

This refers to the process the teacher engages in when identifying the best ways in which to represent key concepts to learners. Central to this process is the "use of a representational repertoire which includes analogies, metaphors, examples, demonstrations, explanations, and so forth" (Shulman, 1987, p. 15).

iii) Selection

The process of selection refers to the choosing of teaching strategies or methods from the "instructional repertoire" (Shulman, 1987, p. 16) of the teacher. The teacher would potentially be drawing on the pedagogical knowledge component of PCK as they decide what would be most effective to counter misconceptions and known areas of difficulty for a topic (Mavhunga, 2012, p. 29).

iv) Adaptation and tailoring

Shulman distinguishes here between two closely linked processes. Adaptation refers to the

process of taking the general learner characteristics into consideration, the "relevant aspects of student ability, gender, language, culture, motivations, or prior knowledge and skills …. conceptions, misconceptions, expectations, motives, difficulties, or strategies" (Shulman, 1987, p.17). Adaptation thus appears to be concerned with the context of the learners, with learner thinking and learner prior knowledge. Tailoring, on the other hand, refers to the fine-tuning a teacher may make through knowledge of a particular class, "a group of a particular size, disposition, receptivity, and interpersonal "chemistry."" (Shulman, 1987, p. 17). Tailoring thus involves the taking of classroom context and classroom climate into consideration.

2.5.3 Instruction

This process refers to the act of teaching. It includes classroom management, presentation of content and interaction with learners. Shulman argues that "teaching behaviour is bound up with comprehension and transformation of understanding" (Shulman, 1987, p. 18) and suggests that teachers will adapt their strategies according to the level of confidence they have about their understanding of the content. Shulman also posits that the "activities of comprehension, transformation, evaluation, and reflection continue to occur during active teaching" (Shulman, 1987, p. 17).

2.5.4 Evaluation

This process refers to the teacher monitoring and reacting to learner understanding while teaching. Evaluation also includes other formative assessment strategies such as feedback and summative assessment. Shulman (1987) writes that to comprehend learners' understanding "will require a deep grasp of both the material to be taught and the processes of learning" (p. 19) and would be topic-specific. Another aspect would be that of teachers evaluating their own performances which feed into the next process of reflection.

2.5.5 Reflection

Shulman refers to reflection as a "set of processes through which a professional learns through experience" (Shulman, 1987, p. 19) by evaluating and reviewing the lesson in terms its goals and purposes. He describes it as the use of "particular kinds of analytic knowledge"

(Shulman, 1987, p. 19) used to "reconstruct, re-enact, and/or recapture the events, the emotions, and the accomplishments" (Shulman, 1987, p. 19).

The Summit Consensus model refers to the development of PCK as reflection *on* action and PCK&S as reflection *in* action (see Section 2.2.1). These terms come originally from Schön (1983, p. 54), but reflection itself has long been championed as a driver of transformative learning and is common to many models of teacher learning, starting with Dewey's concept of reflective thinking (Dewey, 1933). Central to Shulman and Shulman's (2004) model of how teachers learn, is the conjecture that "reflection is the key to teacher learning and development" (p. 264).

Gess-Newsome (2015), referring to the Summit Consensus model, describes how knowledge is produced through reflection on teaching: "Such knowledge grows as teachers individually, collectively, or with a facilitative expert, consider instructional actions and consequences and seek larger perspectives" (p.38). In the Summit Consensus model, the return link from personal PCK to TSPK is now explained. The personal knowledge generated by reflection also has the power to cause teachers to challenge their beliefs and to restructure them. A positive feedback loop may arise in which the contemplation of new beliefs regarding practice may enable teachers to try new teaching practices (Gess-Newsome, 2015, p. 38). In the next section on capturing PCK, the role of collaborative reflection is examined in more detail as a means to making the personal PCK of teachers explicit.

2.5.6 New comprehension

Shulman (1987) suggests that this last process will be a "new beginning" (p. 19) of the reasoning process, but only if aided by "specific strategies for documentation, analysis, and discussion" (p. 19) to ensure that new comprehension occurs.

2.6 The teacher within a professional development system

The Summit Consensus model described above provides thinking tools for describing knowledge, its professional basis, and its transformation as it is reconstructed and put into practice by individual teachers. In order to further understand knowledge construction, this

section also draws on Borko (2004) to understand the influential elements in a teacher professional development system. She defined any professional development system as consisting of the following four key elements:

> The professional development (PD) program;
> The teachers, who are the learners in the system;
> The facilitator, who guides teachers as they construct new knowledge and practices; and
> The context in which the professional development occurs.
>
> (Borko, 2004, p. 4)

These elements were represented in diagrammatic form as shown in Figure 2.2 below. Each of these elements and the relationships between them coming out of research are now briefly described but first the all-encompassing context needs to be explained.

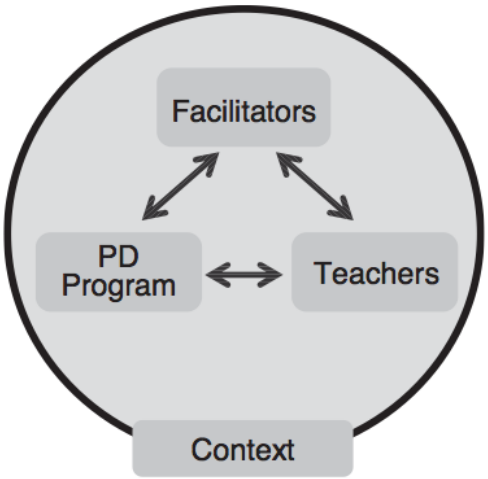

Figure 2.2 Elements of a professional development system (Borko, 2004, p. 4)

2.6.1 Context in which the professional development occurs

Borko (2004) depicts context as surrounding the other three elements of the professional development system. While context is included as one of the important amplifiers and filters in the Summit Consensus model described above, the Borko definition is useful for thinking about context in relation to all three elements. Thus, this model gives further insight into the contextual amplifier/filters in the context of professional development. Each of the three elements – the teacher, the professional development course and the facilitator - are associated with different contexts, which are brought together in a teacher professional development course. Teachers within the professional development system are therefore influenced by their own context, the facilitator's context and the context of the teacher

professional development course. In the case of this research, that means consideration of the context in which the *Fundisa for Change Teaching Life & Living* course is presented. This includes the broader context of curriculum reform out of which the *Fundisa for Change* programme emerged as described in Chapter 1. The argument for contextual consideration is further supported by the work of Opfer and Pedder (2011) who highlight that "underplaying the complexity of the problem [of the nature of teacher learning] leads to focus on the micro context (individual teachers or individual activities or programs)" (p. 378) at the expense of the contextual influences of the school and the schooling system (Opfer & Pedder, 2011; Van Driel, 2014).

Shulman (1987) identified, as one of his seven knowledge bases of teacher professional knowledge, knowledge of educational context that included classroom, school and community context and culture, and describes how teachers take contextual aspects into account during the pedagogical reasoning processes of adaptation and tailoring. The Summit Consensus model shows context as playing an amplifying or filtering role mediating teachers' classroom practices and as classroom context (see Section 2.3.3). Grangeat and Hudson (2015), however, argue that context is "such a crucial element that it deserves a dedicated category" (p. 208) which they develop by drawing on the Summit Consensus model and adapting it using activity theory. The three types of teacher contexts they identify as influencing teacher professional knowledge are the:

- Social context comprising the habits and repertoire of the actions of the teacher group, the orientations, culture and habits of mind of the teacher group and the type of leadership and organization of the collective work
- Classroom context comprising classroom practice and student outcomes
- Instrumental context including teaching resources and materials and in-service education

(Grangeat & Hudson, 2015, p. 220)

All three of these contexts will be referred to in this research.

2.6.2 The professional development programme

In an attempt to explicitly and systematically research the effects of professional development on teacher outcomes, Garet, Porter, Desimone, Birman, and Yoon (2001) conducted a study to investigate the relationship between characteristics of professional

development and teachers' reported learning of knowledge, skills and classroom teaching practices (p. 918). They identified six characteristics of particular interest, divided into two groups of three:

Core features:

- focus on content,
- opportunities for active learning, and
- coherence in terms of goals and standards

Structural features:

- the form the activity takes,
- the duration of the activity, and
- collective participation by groups of teachers. (Garet et al., 2001, pp. 919-920)

Each of these characteristics will now be described and elaborated on to include the further findings of van Driel et al. (2012) in their review of current professional development trends and of Daehler et al. (2015) in their report on professional development features that support the growth of PCK. What becomes clear in the next paragraphs is that careful planning of teacher professional development programmes are key to improving teachers' personal PCK development. However, although these features may facilitate or affect teacher learning, they are not in and of themselves, causal (Opfer & Pedder, 2011).

Focus on content

The link between content knowledge (CK) and PCK has been explored by many researchers with the conclusion that content knowledge is a necessary precursor to the development of PCK (see Section 2.2.2). In their research, Daehler et al. (2015) report that observed patterns suggest that "PCK develops over time and more sophisticated knowledge about teaching seems to be associated with strong CK" (p. 51). This finding caused them to have a focus on content knowledge as a means of supporting PCK development in their professional development programmes. Rollnick's (2016) findings concur with this view as she states that "professional development programs that attempt to improve teachers' CK alone may be simplistic as improvement in content understanding needs to take place alongside an understanding of how the content is to be taught" (p. 33).

Garet et al. (2001) in their research, described the types of activities found in professional development programmes as having four dimensions:

- The relative foregrounding given to the subject matter and teaching methods, in other words, whether the intention is to improve subject matter knowledge, general teaching practice or pedagogical content knowledge;
- the extent to which specific versus general changes to teaching practice are encouraged;
- the emphasis on the learning goals for example for specific skills or for conceptual understanding; and,
- the emphasis on the way learners learn, so focusing on learner understanding of concepts and misconceptions (p. 923).

Garet et al. (2001) wrote that there appeared to be an emerging interest in exploring "the relative effectiveness of professional development activities that focus on learning different types of knowledge, skills, and teaching practices" (p. 924). Coming out of this research is the finding "that professional development requires a dual focus on both knowledge of subject matter content and understanding of how children learn specific content" (Garet et al, 2001, p. 924).

Van Driel et al. (2012) put a greater emphasis on the inclusion of PCK and the learning processes of learners into professional development programmes, adding to this the "need to emphasise contemporary, research-based knowledge concerning teaching and learning" (p. 132). Daehler et al. (2015) suggest that activities that ask teachers "to be metacognitive about what supported and hindered their own learning, as well as what implication their own experiences might have for teaching their own students" (p. 57) can help to keep the foci of teaching and learning closely coupled.

Opportunities for active learning

This feature "concerns the opportunity provided by the professional development activity for teachers to become actively engaged in meaningful discussion, planning, and practice" (Garet et al., 2001, p. 925). These opportunities may take the form of observations or being observed, planning of classroom implementation, reviewing of a learner's work or presenting, leading or writing (Garet et al., 2001, p. 925), feedback and discussion, and reflection, amongst others (van Driel et al., 2012, p. 132). Borko (2004) reported "that

records of classroom practice are powerful tools for facilitating teacher change" (p. 7) as they "enable teachers to examine one another's instructional strategies and student learning, and to discuss ideas for improvement" (p. 7). This finding was reiterated by Grangeat and Hudson (2015) who stated that teacher professional knowledge can be developed through the "collective creation or alteration of teaching material and artefacts, and the enrichment of the repertoire of instructional strategies that is available to teachers as individuals or as a group" (Grangeat & Hudson, 2015, p. 208). In particular, professional development involving opportunities for teachers to be actively involved as learners and partake of forms of collaborative reflection "might contribute to the development of pedagogical knowledge as well as pedagogical content knowledge" (Nilsson, 2015, p. 158). Daehler et al. (2015) advocate that professional development activities should model "exemplary instruction" through "multi-modal learning opportunities" that "push for deep conceptual understanding of both the science and science teaching" (p. 57). Active learning was also reported in the Australian study on professional development by Ingvarson, Meiers and Beavis (2005) as having a significant impact on both teacher knowledge and practice.

Coherence

Coherence refers to the extent to which the professional development activity supports the greater picture of teacher learning. Garet et al. (2001) described coherence in terms of how the professional development builds on a teacher's previous knowledge, its alignment with national standards and requirements, and how it supports the development of a professional community (p. 927). Van Driel et al. (2012) also include under coherence, the requirement of a clear understanding of how the intervention will bring about the intended goals (p. 133). The idea of a professional community is expanded upon by Daehler et al. (2015) who emphasise the importance that "teachers hold the locus of authority in their own learning and develop an identity as life-long learners who are part of a professional community" (p. 57).

The form the professional development takes

Garet et al. (2001) distinguish between traditional workshop-style activities that occur as once-offs, usually outside of school hours and run by experts, and reform-style activities held during school hours with some activities such as observations and mentoring occurring in the classroom.

The duration

There are two variables at play here: the number of contact hours and the spread of hours over time. Professional development spread over time has the advantage of giving teachers the opportunity to experiment in the classroom and give and receive feedback on their experiences (Garet et al., 2001, p. 921). Although it makes common sense that interventions with a longer duration will have greater impact, the optimum length is unclear from research and some has shown that too many hours can also be ineffective (van Driel et al., 2012, p. 133).

Collective participation

This feature refers to the collective participation of specific groups of teachers who attend the professional development programme. These may be teachers from the same school, subject or grade (Garet et al., 2001, p. 922). Van Driel et al. (2012) argue that there is no evidence that shows that conducting professional development within a school is more effective than locating it outside of the workplace and that both can be equally effective (p. 134). The participation of specific groups of teachers creates opportunity for discussion of goals, methods and problem-solving in context. In this way, there is sharing of ideas, knowledge and experiences in the process of "collaborative sense-making" (Daehler et al., 2015, p. 57). Researchers have explored different forms of collaborative reflection in an attempt to make the tacit knowledge of teachers explicit. These forms range from sharing and discussing lesson plans prior to implementation and collective reflection on teacher choices during teaching, to stimulated recall interviews on taught lessons (Nilsson, 2015, p. 157). All appear to provide evidence that "collaborative settings among teachers contribute to the development of pedagogical knowledge as well as pedagogical content knowledge" (Nilsson, 2015, p. 158).

2.6.3 The facilitator

In the professional development review conducted by van Driel et al. (2012), it was noted that the association between the role of the facilitator and the outcomes of professional development programmes were not reflected in most studies. This observation was also made by Borko (2004) some eight years earlier. In her review on research on professional

development, Borko (2004) drew from the literature several tasks for professional development leaders or facilitators: in the planning stage, to "understand the goals of the program and how to use the resource materials to achieve these goals" (p. 10) reflected through the structuring of the sessions and the activities that make up the learning experiences; and in the enactment stage, to "help teachers to establish trust, develop communication norms that enable critical dialogue, and maintain a balance between respecting individual community members and critically analyzing issues in their teaching" (p. 7). To achieve the latter, the facilitator needs to be responsive to the participants and the discourse (Borko, 2004). The ability to perform these tasks would all form part of the facilitator's professional development-PCK. The teacher-educator professional knowledge bases include subject matter knowledge consisting of both content knowledge and knowledge for teaching, pedagogical knowledge of effective professional development practices including assessment practices, knowledge of the development of pre-or in-service teachers and curricular knowledge (Cooper, Loughran, & Berry, 2015). Amongst these practices would be the key competencies of, for example, explicit modelling of the pedagogical reasoning behind the use of a particular pedagogical strategy (Loughran & Berry, 2005) and the modelling of reflective practice (Loughran, 1996).

An additional issue is the extent to which the program resource materials provided to the facilitator can ensure fidelity to the programme designers' original goals (Borko, 2004, p. 12). Implementation of programmes in different contexts will usually require some adaptation. However, programme designers would need to "investigate the balances and tradeoffs between fidelity and adaptation, and consider which elements of a program must be preserved to ensure the integrity of its underlying goals and principles" (Borko, 2004, p. 13).

2.6.4 The teachers

Shulman and Shulman (2004) in their model of teacher learning communities propose that the dimensions of an accomplished teacher are: "Ready (possessing *vision),* Willing (having *motivation),* Able (both *knowing and being able 'to do'),* Reflective (learning *from experience),* and Communal (acting *as a member of a professional community)*" (p. 259). They note that the challenge for professional development is working out what activities would best cause the kind of learning that would result in such a teacher. Their suggested solution is critical reflection on teaching practice and learner learning (Shulman & Shulman,

2004, pp. 263-264). As reported by Borko (2004), teachers are usually quite happy to talk about their classroom experiences, but conversations that critically examine teaching need to be nurtured "if teachers are to collectively explore ways of improving their teaching and support one another as they work to transform their practice" (p. 7). This access to a "community of colleagues" (Clarke & Hollingsworth, 2002, p. 955) with whom experiences could be shared and reflected upon, is described as a key feature of the professional development environment that could either enable or constrain professional growth.

2.7 Summary

This chapter has defined PCK as personalised and contextualized knowledge for teaching a particular topic. PCK was further described as emerging from teacher professional knowledge and influenced by the filtering or amplifying powers of teacher beliefs, orientations, prior knowledge and context. The knowledge components of PCK were identified as: assessment knowledge; pedagogical knowledge; content representations; content knowledge; learner understandings; and, curricular knowledge. The processes of pedagogical reasoning behind the choices teachers make in planning for teaching, were also described. Lastly, the relationships between the teachers, context, the facilitator and the professional development activities in terms of the development of teacher PCK were explored.

Chapter 3 Research design

3.1 Introduction

This chapter starts with a description of the ontological and epistemological assumptions made as a means of framing the chosen research orientation. The rationale behind the research design of the study and data generation instruments used is outlined and the practicalities of the data generation process are described. The chapter shows how the data generated relates to the research questions and the theoretical framework detailed in Chapters 1 and 2 respectively. This is followed by an explanation of the data analysis procedures. Lastly, a description of the accommodation into the research design of issues relating to validity and ethics is also given.

3.2 Research orientation

Approaches to educational research fall into two broad categories of understanding social reality: objectivist and subjectivist approaches (Cohen, Manion, & Morrison, 2007, p. 7). These two views are distinguishable by the ontological, epistemological, human nature and methodological assumptions on which they are based (Cohen et al., 2007, pp. 7-8). Objectivist studies are described by Cohen et al. (2007) as viewing social reality as "knowable as it really is" (p. 10), ascribing to the positivist view of knowledge as "objective and tangible" (p. 7), thus requiring objectivist studies to rely on observation of people "responding mechanically and deterministically to their environment" (p. 8) through the application of "nomothetic" (p. 8) research methods designed to enable generalisations to be made. On the other hand, subjectivist studies, according to Cohen et al. (2007), describe the world as "the product of individual consciousness" (p. 7) and knowledge as "personal, subjective and unique" (p. 7), thereby making an anti- or post-positivist stance more appropriate for "ideographic" (p. 8), qualitative techniques that are aimed at uncovering the ways in which people interpret their environment.

According to Cohen et al. (2007) positivist views are characteristic of the normative paradigm in social science research, with its quantitative methods and "rule-governed" (p. 21) approach to behaviour. An anti-positivist approach to social science research is broadly

associated with an interpretive paradigm and strives "to understand the subjective world of human experience" (Cohen et al., 2007, p. 21). An interpretive approach is supported by research methods generating qualitative data, which, Yin (2011) argues, display certain features: They involve the representation and explanation of the views and perspectives of real people through their social interactions and/or actions, within the context in which they have taken place and using a variety of data sources (pp. 8-9).

This study explores teachers' emergent environmental PCK during the *Fundisa for Change* teacher professional development course. Given the purpose of the research, it was felt that an interpretivist study would be most useful. An approach was needed that would enable rich description of the professional development experience as well as identifying the opportunities for the development of environmental PCK. As PCK is for the most part implicit, particular strategies were used to elicit teachers' PCK. The study was therefore predominantly reliant on qualitative research methods and data generation with a minor quantitative component in the form of descriptive statistics. A case study methodology was used where I played a participant-observer role. The next section explains this choice in more detail.

3.2.1 Case study as a methodological approach

The choice to conduct a case study was informed by a need to understand the dynamics of the *Fundisa for Change* professional development system with all its complexities, as teachers grapple with new environmental knowledge. A case study is a documented occasion of a clearly bounded event (O'Leary, 2004, p. 115). In this case, the bounded event is an iteration of the *Fundisa for Change* professional development course run in the form of five three-hour-long sessions, three in February and two in May of 2016. According to Shulman (1986), "a case must be explicated, interpreted, argued, dissected, and reassembled." (Shulman, 1986, p. 12). The case study approach has provided an opportunity to examine the development of teachers' environmental pedagogical content knowledge in a *Fundisa for Change* course in detail "recognising that context is a powerful determinant of both causes and effects" (Cohen et al., 2007, p. 253).

Developing the definition of a case study further, Yin (2003) highlights that as a result of a case study having multiple uncontrolled variables, it "relies on multiple sources of evidence,

with data needing to converge in a triangulating fashion, and as another result, benefits from the prior development of theoretical propositions to guide data collection and analysis" (Yin, 2003, p. 14). Thus the case study, as a research strategy needing to ensure triangulation, encompasses many data generation techniques. This research focused predominantly on methods that generated qualitative data namely a teacher contextual profile questionnaire, observations (video- and audio-recordings), participant outputs, course materials and a semi-structured reflection and evaluation questionnaire. Understanding of the elements of the course, the participants' perceptions of the course, the activities making up the course and the participants' emergent environmental PCK was captured through rich description.

Yin (2003) distinguishes, based on the type of research questions, between three types of case studies: exploratory "to develop pertinent hypotheses and propositions for further inquiry" (p. 6), descriptive "to describe an intervention and the real-life context in which it occurred" (p. 15) and explanatory "to explain presumed causal links" (p. 15). The objective of this research was primarily to describe the event of the teacher professional development course and the context in which it occurred. To achieve this, a descriptive case study research design was used to describe the support and construction of environmental PCK in a *Fundisa for Change* teacher professional development course.

3.2.2 Research participants and gaining access

As mentioned in Section 1.3, the research participants were the seventeen teachers completing a two-year part-time Advanced Certificate in Teaching (ACT) Senior Phase Natural Sciences in-service training course at UCT. The ACT entails commitment to traveling to attend lectures, often twice a week, for three hours, from 4 to 7 pm, after school. The *Fundisa for Change Teaching Life & Living* course was taught as part of the ACT lectures at venues located on the UCT campus. At the time of the study, the teachers were all teaching within the South African state system at schools within the Metropole Education Districts of Cape Town, with roughly half teaching at primary school level. A summary of the teachers' demographic and biographic details is given in Table 4.6. Wherever possible, all seventeen teachers were involved in the data generation process.

3.3 Methods of data generation

The research objective was to obtain detailed information about teachers' environmental personal PCK as they participated in the *Fundisa for Change* professional development programme. Methods were needed that would capture the dynamics of the *Fundisa for Change* course as a professional development system, including the opportunities created by the course for the development of PCK, and to identify emergent PCK during the course. These methods included document analysis, a teacher contextual profile questionnaire, observations, course activity outputs including lesson plans and CoRe 'Big ideas' templates, and a form for course evaluation and reflection. The table below lists the data generation methods and sources while relating these to each research sub-question.

Table 3.1. Relating the data generation to the research questions

Research question: How is the development and emergence of environmental pedagogical content knowledge supported and constructed in the *Fundisa for Change* teacher professional development course?

Research sub-questions	**Data generation method**	**Source/participants involved**
SUB-QUESTION 1: What are the elements and the relationships between them in the *Fundisa for Change* teacher professional development system?	Contextual profile questionnaire	Seventeen individual participants
	Document selection – *Fundisa for Change* course materials and policy documents for partners	*Fundisa for Change* booklets: 1. *Introductory Core Text* 2. *Framing Active Teaching and Learning in CAPS.* 3. *Methods and Processes to Support Change-oriented Learning* Documents for Partners: 4. *Guidelines for Facilitation of the Fundisa for Change Teacher Education Programmes*. 5. *Fundisa for Change Partnership Protocol*
	Observations – Video recordings of course sessions	Video recordings showing entire class for each of the five sessions
	Document selection – Participant outputs	Group outputs collected from all groups during course activities: *Activity 2 'Build a better world'* *Activity 3 'Life & Living: Ecology in the CAPS'* mind map *Activity 5 'Evaluating the sequence of methods'* *Activity 6 'The water cycle'* *Activity 7 'Big Ideas'* section *Activity 8 'Assessment discussion'* *Activity 9 'Assessment vignettes'* Six individual outputs during course: *Activity 7 'Lesson plan'* section

	Observations - Audio-recording of group discussions during activities	Group discussions during activities recorded for 2 groups (roughly 8 teachers) at each of five sessions
	Course reflections and evaluation	Sixteen individual participants

SUB-QUESTION 2: What are the amplifiers and filters affecting the development of teacher PCK in the *Fundisa for Change* teacher professional development system?	Contextual profile questionnaire	Seventeen individual participants
	Document selection – Participant outputs	Group outputs collected from all groups during course activities: *Activity 2 'Build a better world'* *Activity 3 'Life & Living: Ecology in the CAPS'* mind map *Activity 5 'Evaluating the sequence of methods'* *Activity 6 'The water cycle'* *Activity 7 'Big Ideas'* section *Activity 8 'Assessment discussion'* *Activity 9 'Assessment vignettes'* Six individual outputs during course: *Activity 7 'Lesson plan'* section
	Observations - Audio-recording of group discussions during activities	Group discussions during activities recorded for 2 groups (roughly 8 teachers) at each of five sessions
	Course reflection and evaluation	Sixteen individual participants

3.3.1 The teacher contextual profile questionnaire

A contextual profile questionnaire (see Appendix C) established background information on all of the teachers. The existing *Fundisa for Change* questionnaire was adapted to include questions that would also give insight into the elements of the professional development system and the context within which the professional development programme occurred, in order to build up a comprehensive contextual picture (as described in Section 2.6.1). In particular, identifying the amplifiers and filters mediating teacher knowledge during the course (see Section 2.3) would help me to understand the relationship between the professional development programme and the teachers.

The questionnaire was designed as a survey for describing aspects of the participants and their contexts (O'Leary, 2004, p.153) and to aid the answering of research Sub-Question 1 and Sub-Question 2. This means it was used as a descriptive tool to establish: a) some demographic information about the teachers, b) information about teachers' beliefs, attitudes and orientation to teaching and learning, c) information about the context in which they teach, and d) information about their learners and the social context of the learners.

Purposeful adaptation and development of the questionnaire enabled the generation of information about the amplifiers and filters relating to existing teacher beliefs, orientations, prior knowledge and context as well as classroom context. In this way, it asked "the most appropriate *kinds* of question" (Cohen et al., 2007, p. 320) and elicited "the most appropriate *kinds* of data to answer the research purposes" (Cohen et al., 2007, p. 320). The questionnaire included both open-ended questions to generate the rich, personal data needed and questions with defined response categories to elicit background detail and in some cases to support or confirm the data in the open-ended questions.

The contextual profile questionnaire was given to all of the teachers at the first session of the course as a take-home task and collected at the following session. The work on producing the questionnaire was predominantly influenced by, and drew on, the two sources detailed below. Some questions from the existing *Fundisa for Change* questionnaire were also included. These are also detailed below.

1. Teacher Beliefs Interview tool

Luft and Roehrig (2007) developed a series of questions they used in semi-structured interview format to elicit responses to explore science teachers' beliefs about learning and knowledge as a means to gauge effectiveness of their pre-service training programmes. These questions were developed over time and were rigorously tested for validity. The emergent categories from their Teacher Belief Interview (TBI) are traditional, instructive, transitional, responsive and reform-based. The traditional and instructive categories represent teacher-centred beliefs while the responsive and reform-based categories represent learner-centred beliefs. The transitional category focuses on behavioural aspects of learners as against cognitive aspects. These beliefs were also linked to the teachers' view of science. "Specifically, traditional responses reveal science as based on facts, rules and methods that are transferable; transitional responses represent science as a body of certain knowledge; while reform-based responses support science as a dynamic field that is subject to revision" (Luft & Roehrig, 2007, p. 42).

The TBI questions had already undergone validity and reliability testing. Although designed as interview questions, the TBI was used as part of the questionnaire. Small modifications to spelling, replacement of the word 'student' with 'learner' and some re-wording adjusted the

questions to a South African context. All seven of Luft and Roehrig's (2007) questions were included in the questionnaire and are shown in Table 3.2 below along with the purpose of each question.

Table 3.2 The modified seven Luft and Roehrig (2007) Teacher Beliefs Interview questions

Question numbered as in the Teacher Contextual Profile Questionnaire	**Reveals how teachers view …**
Section 2AQ2. How do you describe your role as a teacher?	Knowledge
Section 2AQ4. How do you maximise learning in your classroom?	Learning
Section 2AQ7. How do you know when your learners understand?	Learning
Section 2AQ8. How do you decide when to move on to a new topic in your class?	Knowledge
Section 2BQ8. How do you decide what to teach and what not to teach within a particular topic?	Knowledge
Section 2BQ9. What types of learning activities do you see the learners benefiting from the most?	Learning
Section 2BQ10. How do you know when learning is occurring in the classroom?	Learning

2. Teaching and Learning International Survey (TALIS)

The TALIS is a survey administered across 34 countries for its second iteration in 2013 by the Organisation for Economic Co-operation and Development (OECD), unfortunately not including South Africa. The TALIS focused on establishing the contexts in which teachers work and the learning environment of the classroom and was designed to be used by countries for comparison purposes and policy development (OECD, 2014b, p. 21). Questions from the TALIS chosen to be included in the teacher contextual profile questionnaire related to classroom climate, learner context, teacher beliefs and attitudes as well as teaching and assessment practices (see Table 3.3 below). These questions were deliberately chosen for the potential information they might yield as to contextual amplifiers and filters and about classroom context.

Table 3.3 TALIS questions selected for inclusion, as well as focus area of question

Question location within the Contextual Profile Questionnaire	**Focus area of question**
Teachers instructional practices and beliefs	
2AQ1	General beliefs about the nature of teaching and learning (Constructivist vs. direct transmission)
2AQ6	Learner assessment methods (formative and summative)
2BQ6	Instructional practices (Student oriented, structured, enhanced activities)
Contextual information about the teachers	
1Q1	Work experience
1Q2	Elements included in formal education or training
1Q3	Hours spent working over and above in the classroom
2BQ1	Science subjects taught
Teachers' professional practices	
2AQ3	Co-operative behaviours among teachers – opportunities for the informal development of PCK (Exchange and coordination for teaching and professional collaboration)
2AQ5	Teacher self-efficacy (Efficacy in learner engagement, efficacy in classroom management and efficacy in instruction)
Teachers' classroom context with respect to learners	
2BQ2	Choice of target class
2BQ3	Target class size
2BQ4	Perceived ability of target class
2BQ7	Time percentage spent on admin, discipline and teaching
2BQ11	Classroom disciplinary climate

3. Additional questions in the Teacher Contextual Profile Questionnaire

Several questions in the contextual profile questionnaire were retained from the existing *Fundisa for Change* questionnaire. These questions are about the teachers' classroom context with respect to learners (see Table 3.4 below).

Table 3.4 Additional questions relating to the teachers' knowledge of learners

2BQ5	For your target class, estimate the broad percentage of learners who have the following characteristics: first language different from language of instruction; academic support at home; access to resources; above average age for the grade; and, motivated to achieve.
2BQ12	Are there any specific challenges you have with this group of learners?
2BQ13	Based on your past experience, what are the areas of knowledge in this subject that learners tend to perform well in?
2BQ14	Why do you think that learners perform well in the area mentioned above?
2BQ15	What key environmental content and concepts in your subject are learners struggling to learn?
2BQ16	Why do you think that learners struggle with the concepts you mentioned above? What is it about the concepts that make them difficult?
2BQ17	What type of activities (outside of the classroom or jointly with other classes) are learners in your school involved in that support their environmental content knowledge?

A colleague reviewed the questionnaire in its entirety prior to it being administered. Wording was adjusted, checks made for ambiguity, unnecessarily complex language, leading or biased questions and any offensive questions. Open-ended and closed-ended questions were deliberately mixed in the questionnaire in an attempt to avoid respondents becoming bored.

Despite this checking process, two issues arose both involving responses to closed-ended questions that yielded unexpected answers, indicating that teachers had potentially misinterpreted the questions. These issues were followed up in a subsequent session with the teachers so that they could verify their responses. Where necessary, their responses were modified on their original questionnaire.

Another issue arose after data collection when it was noticed that a tick-response question with nineteen parts had the same option ticked throughout by the respondent. As the same option was not possible, or at the very least highly unlikely, the data for that question was not included in any analysis.

3.3.2 Observation – video of overall course implementation

Maxwell (2008) argues that: "for observation, rich data are the product of detailed, descriptive note-taking (or videotaping and transcribing) of the specific, concrete events that you observe" (p. 244). All of the sessions with the participants were video-recorded. Recording equipment was left unmanned for as much of the time as possible so as not to draw the participants' attention to it. For the study, my role was that of participant-observer in that I was one of the facilitators of the professional development system being observed. My positioning as researcher/facilitator is discussed further in Section 4.4.1.

To be able to give adequate space to the two roles of participant and observer, observation of the course sessions was carried out after each session, with observation notes being made from the video recording using an observation form (see Appendix D for an extract of a completed lesson observation form). This enabled me to focus on my facilitation role during the course sessions. However, there had to be some awareness of the recording process during the enactment as periodically the equipment would need checking or the tape in the video would need to be changed. The lesson observation form used had a simple structure with three columns headed: time, what the teacher/facilitator is doing, and what the

learners/teachers are doing. In this way the actions of the teachers and myself were identified in order to make the professional development strategies more explicit. This unstructured approach enabled multiple reviews of the recorded observation data from different perspectives during the analysis phase of the study. The lesson observation forms resulted in the summary descriptions of the sessions describing who was doing what and when and are presented in Section 4.2.

The purpose of the course observation was, however, to be able to give a *detailed* description of the content of the proceedings of this particular iteration of the *Fundisa for Change* course. To achieve this purpose, the video recording was also used to create a transcript of all my and Nomvuyo's facilitatory interactions with the class, groups and individuals during the course sessions. The lesson observation form was used to provide the context for the transcript, to identify whom the facilitators was addressing, what the teachers were doing and so on.

3.3.3 Observations - Audio-recording of group discussions

Throughout the course, teachers worked in groups of four or five. The research required the in-depth analysis of group discussion during the sessions. For this purpose, in all of the five three-hour-long sessions, two iPods were used to capture audio from two groups at a time. Groups were chosen for audio-recording based on members' interest in participating in the research and their expressiveness and active participation in the course. The choice of interested, expressive and active participants was to enable rich data generation. As the group members varied from session to session, most of the teachers were part of an audio-recorded group at least once.

The teachers were aware that they were being recorded as this had been one of the items on the consent form that had required their approval. The iPods were left on the tables in an open plastic container and switched on before the participants arrived so as not to draw their attention to them. After listening to the recordings from the first session, I realised that I had to move the containers to the centre of the table to capture the audio from all the group members more clearly.

The purpose behind recording the group discussions was predominantly to identify the PCK emerging during discussion on the *Fundisa for Change* course. In her literature review of

transcription as a research method, Davidson (2009) points out that a common view is that transcription is "a process that is theoretical, selective, interpretive and representational" (p. 37) in that the researcher selects what to transcribe in terms of their theoretical position, and what to include in the transcription in terms of speech and/or non-verbal communication. In this study, ten three-hour-long recordings (of two groups for each of the five sessions) were transcribed fully in preparation for analysis as, although the audio data was lengthy, it contained a large amount of dense information that would inform the selection of categories for theme analysis. A sample page of one of the transcriptions is given in Appendix E. Transcriptions mostly detailed verbal data, however, some non-verbal elements were added where appropriate to contextualise the selection as well as, for example, to indicate pauses, laughter, or tone (O'Leary, 2004, p. 141).

With four group members and participants speaking, often at the same time, the task of transcription was challenging. Davidson (2009) acknowledges that challenges around transcribing multi-party talk have not been adequately addressed in the literature (p. 47). This issue raises questions around the trustworthiness of transcription. To ensure trustworthiness, the transcriptions were checked by a second person and where words could not be clearly recognised the word 'inaudible' was inserted as a placeholder. Minimal translation was required because, although participants on occasion interjected Afrikaans, isiXhosa and/or Shona comments into their English, these comments tended to be personal in nature and not related to the course work.

3.3.4 Document research

Cohen et al. (2007) describe document analysis as the study of recorded human communication. There were two types of documents analysed for this study. These are detailed below.

1. Participant outputs from course activities

During the course, teachers worked in groups on several professional development activities designed to develop their understanding in the three focus areas of the *Fundisa for Change* course: content, teaching practice and assessment practice. The outputs from these activities complemented the audio-recordings of the group discussions during the activities. In

particular, they were used as evidence in answering the main research question as sources of potential examples of the emergent environmental PCK from the *Fundisa for Change* course.

A list of the activities from all the sessions, along with the outputs collected for the purpose of data analysis, is given in Table 3.5 below. The intended goal of the activity and targeted area of teacher professional knowledge is also provided.

Activity 7, mentioned in the table below, was given as an assignment and was also used as a data generation tool. It had two parts: the CoRe template and the lesson plan. Both these parts provided opportunities for gaining insight into teachers' PCK. Over the past decade, researchers Cooper, Loughran and Berry (2015) have searched for "ways of capturing, documenting, and portraying experienced science teachers' PCK so that it might be useful from a teacher's point of view" (p. 61). One of the key challenges facing them was the tacit nature of PCK and the absence of a way for teachers to speak about their teaching (Cooper et al., 2015).

Table 3.5 Summary of the activities and their outputs, intended goals and knowledge bases

Activity	**Output**	**Goals**	**Knowledge**
1. Movie	Not collected from individual groups, but class feedback recorded on board and photographed	Develop biodiversity conceptual knowledge Model teaching strategy of active listening Consider usefulness in own context	Content knowledge Pedagogical knowledge Knowledge of learners
2. Build a better world	Newsprint page of group's definitions of sustainability, adaptation, equity, resilience and transformation	Encourage discussion about concepts of the environment and society while developing common understanding of terms Consider usefulness in own context	Content knowledge Pedagogical knowledge Knowledge of learners
3. Life & Living: Ecology in the CAPS	Mind maps of ecology concepts from Grade 4 – Grade 8	Track progression of environmental concepts through the intermediate and senior phases Model mindmapping as teaching strategy	Curricular knowledge Pedagogical knowledge
4. Exploring teaching methods	Not collected	Remind teachers of the wide range of teaching strategies available	Pedagogical knowledge
5. Evaluating the sequence of methods used in a programme of learning	Newsprint page of table showing sequence of activities, goals and teaching strategies	Stimulate thinking about how different teaching strategies can serve different goals or purposes.	Pedagogical knowledge
6. The water cycle	Newsprint diagrams illustrating water flow through the earth's systems	Engage with water cycle content knowledge by representing it in different ways Model rubric use and feedback as formative assessment strategy	Content knowledge Pedagogical knowledge Assessment knowledge
7. Big Ideas and lesson plans	Completed content representation templates and individually completed lesson plans	Plan in detail a specific topic while taking concepts, context and learners into consideration	Curricular knowledge Pedagogical knowledge Knowledge of learners
8. Assessment discussion	Newsprint page of answers to discussion questions	Stimulate discussion of assessment issues	Assessment knowledge
9. Assessment vignettes	Not collected from individual groups, but class feedback recorded on board and photographed	Develop understanding of the distinctions between formative and summative assessment strategies	Assessment knowledge
10. Assessment of CAPS environmental learning	Not collected	Identify knowledge and cognitive levels of CAPS assessments for environmental topics and process skills	Assessment knowledge Curricular knowledge

CoRe (Content Representation) templates were introduced by Loughran, Mulhall and Berry (2004) as a tool to assist in making a teacher's personal PCK explicit through the answering of a series of questions relating to 'Big Ideas', "ideas that teachers see as crucial to students' understanding of a specific topic" (Cooper et al., 2015, p. 62). Through these questions, they "began to access aspects of teachers' content-specific pedagogical reasoning that helped to provide insights into their tacit knowledge of practice" (Cooper et al., 2015, p. 62). Table 3.6 below shows the CoRe template questions with explanations of each from the work of Loughran, Berry and Mulhall (2012, pp. 17-19) and the components of topic-specific PCK they are designed to elicit and develop.

Bertram (2012) writes that the questions in the CoRe "offered a language for participants to begin to better articulate their knowledge of practice" p. 216). In his study, he found that teachers "constructing their own CoRes encouraged structured reflection and helped them to be much more conscious of their students' learning" (Bertram, 2012, p. 216). To help teachers develop the language required to articulate their thinking when working with the questions and Big Ideas of the CoRes, it is suggested that teachers work in small groups, possibly also with the assistance of a facilitator to "focus and frame their thinking" (Cooper et al., 2015, p. 63). Working through the questions in small groups also creates the opportunity for teachers to "co-construct a visible representation of their collective TSPK [Topic Specific Professional Knowledge] " (Gess-Newsome, 2015, p. 23). Completing a CoRe template was given as a group activity during the contact time of the course whereas the lesson plans leading from the CoRe were individual take-home tasks. For this activity, teachers were put into groups to discuss grade-specific topics. In addition, teachers worked on topics that they were yet to teach that year as a means of making the planning for the topic more relevant and useful to them.

The completed CoRe templates of the Grade 6 and Grade 7 groups of teachers are included in Appendix L as examples. Together, the CoRes and the lesson plans derived from them had the potential to create an understanding of that group of teachers' planning and teaching ideas regarding the environmental topic they were focusing on.

Table 3.6 CoRe template questions, explanations and related components of PCK

CoRe questions (adapted from Loughran, Mulhall, & Berry, 2004, p. 376)	**Explanation** (from Loughran, Berry, & Mulhall, 2012, pp. 17-19)	**PCK Component and/or other knowledge base**
Big ideas	These are the crucial concepts for the conceptual understanding of the content of the topic	Content knowledge Curricular knowledge
What do you intend the learners to learn about this idea?	This questions provides a starting point where teachers explain their understanding of what is important to the content area in more detail	Content knowledge Curricular knowledge
Why is it important for the learners to know this?	This question probes teachers' understanding of how the concepts link either to other aspects of the curriculum or to everyday life.	Content knowledge Curricular knowledge
What else do you know about this idea that you do not intend learners to know yet?	This question elicits the teacher's knowledge of the detail required for understanding of the content at a particular grade level	Content knowledge Curricular knowledge
What difficulties/limitations are connected with teaching this idea?	This question surfaces teachers' understanding of how learners learn, how to avoid misconceptions and what content representations work best for the concepts	Knowledge of learners
What do you know about learner thinking which influences teaching about this idea?	This question draws out the influence of past experiences in teaching a topic on teachers' thinking	Knowledge of learners
Are there any other factors that influence your teaching of this idea?	This question provides an opportunity for the influence of contextual knowledge about learners to be described	Knowledge of learners
What teaching procedures would you use, and why, for this idea?	This question encourages teachers to think about the range of teaching procedures available, and how and why they would use them	Pedagogical knowledge
How would you ascertain learner understanding of, or confusion about, this idea?	This question elicits teachers' use of formative and summative assessment strategies to track learner understanding	Assessment knowledge

2. Fundisa for Change course materials

The *Fundisa for Change* teacher professional development course materials were examined from two perspectives: Firstly, in terms of what they bring into the teacher professional development system; and secondly, in terms of the opportunities for the development of environmental PCK presented in the activities.

The primary data source used from the course materials was the *Introductory Core Text* booklet. Other data sources included two booklets given to teachers during the course and two documents produced by the *Fundisa for Change* team for partner organisations wishing to run the course. The course booklets are:

- *Introductory Core Text*
- *Framing Active Teaching and Learning in CAPS*
- *Methods and Processes to Support Change-oriented Learning*

The two documents for partners are:

- *Guidelines for facilitation of the Fundisa for Change teacher education programmes*
- *Fundisa for Change Partnership Protocol*

These materials were written in 2013 by members of the Environmental Learning Research Centre at Rhodes University, South Africa. The target audience was teachers and teacher educators. The type of data looked for from these documents referred mainly to their proposed or implied use in the *Fundisa for Change* teacher professional development programme. The *Introductory Core Text* outlines a course for teachers. As a way of addressing the degree of fidelity to this document, the *Introductory Core Text* course was compared to the enacted course (see Section 4.4.2). This helped to identify the adaptations that facilitators made to the *Introductory Core Text* course as they planned for the course enactment. This adaptation is driven by the facilitator's amplifiers and filters in the form of their own beliefs, orientation, prior knowledge and context. The analysis of these documents helped with answering Sub-Question 1.

3.3.5 Course reflection and evaluation form

All participants completed a course reflection and evaluation form (see Appendix F) at the end of the first three sessions. This form focused on identifying the aspects of the course and activities that the participants thought useful or relevant to their understanding and professional development. A variety of themes emerged from the form. Evidence of the components of PCK were also specifically looked for. The form for reflection and evaluation provided useful information as to the teachers' understanding of the activities and was used to answer Sub-Questions 2 and the main research question. One participant did not complete a form, so the number of forms was reduced to sixteen. The forms were completed anonymously and labelled Teacher A, REF to Teacher P, REF.

3.4 Data management

Hard copy data were systematically filed and stored, with copies kept in a safe place. Electronic data files were backed up and stored safely. The data sources used, along with their purpose with respect to the sub-question using the data, the date on which the data was generated and the recording method used, are included in Table 3.7 below. This is followed by an explanation of the indexing system used for the generated data.

Table 3.7 Data Source, purpose, date/s generated, recording method

Data set	Data source	Purpose of data source	Dates	Recording method
1	Teacher contextual profile questionnaires from 17 teachers.	To establish: teachers' biographical information; teachers' beliefs, attitudes, orientation and experience; classroom and school teaching context; and learners' context. Sub-Question 1 and 2	18 Feb 2016	Hard copies stored. Data was transcribed from questionnaire into Excel workbook.
2	Video-recording of all five sessions. Each session is between 2 ½ - 3 hours long.	To enable observation notes to be made on the structure and contents of the course. To identify the role of the facilitator – what the facilitator is doing. To identify what the teacher is doing. Sub-Question 1	18, 23, 25 Feb and 24, 31 May 2016	Video cassettes stored. Video-recording viewed by facilitator to make observation notes and transcribed to record facilitator interactions with groups.
3	Audio-recordings of group discussions during activities of two of the 4 groups, each with 4 teachers.	Used to identify organisational and substantive themes and categories. Sub-Questions 1 and 2 Used to identify theoretical categories of components of PCK, evidence of pedagogical reasoning and reflections. Sub-Question 1 and 2	18, 23, 25 Feb and 24, 31 May 2016	Audio-recordings saved electronically and transcribed. Transcriptions were scanned for group discussion topics and themes and categories identified.
4	Document selection – *Fundisa for Change* course materials and two documents for partners	Used to understand the course contents, objectives and the amplifiers and filters applied by the facilitator in selecting material for the course. Sub-Question 1 and 2		Relevant extracts selected and highlighted electronically, then sorted into an analytic memo. Used for comparison with enacted course.
5	Document selection – participant group outputs: 4 groups doing 8 activities. (Total of 32 items)	Used to identify development of teacher PCK. Sub-Question 1	18, 23, 25 Feb and 24, 31 May 2016	Photographs of teachers' group work, some of which is transcribed.
6	Document selection – participant individual output of 17 lesson plans, 6 of which to be analysed in detail	Used to explore the lessons that were planned by the teachers. Sub-Question 1	April 2012	Teachers submitted lesson plans electronically.
7	Form for course reflection and evaluation from 16 teachers.	Self-report of knowledge with regard to individual activities. Reflections and evaluations of course as a whole. Sub-Question 1	14 April 2016	Hard copies stored. Transcribed from forms into Excel workbook.

A labelling system enabled easy access to data in both hard copy and electronic forms. Table 3.8 below includes the codes allocated to each of the data sets.

Table 3.8 Data source and codes for each data set

Data set	Data source and code explanation	Index Code/Label
1	Teacher contextual profile questionnaire from 17 teachers Coding for questions: Section 1: Questions 1 – 3 Section 2A: Questions 1 – 8 Section 2B: Questions 1 – 17	CPQ1 - CPQ17 1Q1 – 3 2AQ1 – 8 2BQ1 – 17
2	Video-recording of five teaching sessions of between 2 ½ - 3 hours long each. Tapes are 1 hour long, so three tapes needed for each session. Session 3 has two tapes. Session observations Facilitator input transcribed for each session. (Transcript Facilitator (Session number))	Session 1: VT1 – VT3 Session 2: VT1 – VT3 Session 3: VT1 – VT2 Session 4: VT1 – VT3 Session 5: VT1 – VT3 S1OBS – S5OBS TM1 – TM5
3	Audio-recordings of two of the four group's interactions and discussions during each of the five sessions. ((Audio Tape (Session number) Group (Group number)) Transcription from these audio-recordings: 1) Segments during which group discussion occurs, are transcribed and put together in a single file for each session. ((Transcript Audio Tape (Session number) Group (Group number))	AT1G1; AT1G2 AT2G3; AT2G4 AT3G1; AT3G2 AT4G2; AT4G3 AT5G1; AT5G2 TAT1G1; TAT1G2 TAT2G3; TAT2G4 TAT3G1; TAT3G2 TAT4G2; TAT4G3 TAT5G1; TAT5G2
4	Document selection – *Fundisa for Change* course material: • *Framing Active Teaching and Learning in CAPS* • *Introductory Core Text* • *Methods and Processes to Support Change-oriented Learning* The two documents for partners are: • *Guidelines for facilitation of the Fundisa for Change teacher education programmes* • *Fundisa for Change Partnership Protocol*	 (O'Donoghue, 2013) (Fundisa for Change Programme, 2013) (Rosenberg et al., 2013) (Fundisa for Change Programme, 2014) (Rosenberg & Lotz-Sisitka, 2013)
5	Document selection – participant group outputs: 4 groups doing 8 activities *1. Movie* (class feedback on board - photo) *2. Build a better world* *3. Life & Living: Ecology in the CAPS* *4. Exploring teaching methods* – no output *5. Evaluating the sequence of methods* *6. The water cycle* *7. Big ideas and lesson planning* Assignment: CoRe Big Ideas (Grade groups - 6 groups in total) Lesson plans (individual) (Grade, teacher number) *8. Assessment discussion* *9. Assessment vignettes* (class feedback - photo) *10. Assessment of environmental learning in the CAPS* – no output	 MAP G1BW(1) – G4BW(2) G1MM – G4MM G1EM(1) – G4EM(2) G1WC(1) – G4WC(2) CoReGr4 – CoReGr9 LPGr4T1 – LPGr9T2 G1A – G4A CFAV
6	Document selection – participant individual output of lesson plans.	ILP1 – ILP17
7	Course reflection and evaluation forms from 16 teachers.	Teacher A, REF, Q1.1 – Teacher P, REF, Q3.3

3.5 Data analysis

Qualitative data analysis is described by Cohen et al. (2007) as a sense-making activity in which one organises and explains data. Maxwell (2008) identifies three types of strategies for qualitative data analysis (p. 236). The first is the categorising strategy of identifying and coding of themes from the raw data to develop meaningful understanding. According to O'Leary (2004), identifying and coding of themes often uses cycles of inductive and deductive reasoning (p. 195). Deductive reasoning in this situation refers to "uncovering" (O'Leary, 2004, p. 195) of themes in order to establish meaningful understanding (O'Leary, 2004). A deductive approach is being used by O'Leary (2004) to refer to the use of theory and concepts as suggestive of categories and themes. An inductive approach refers to allowing the data to generate themes or concepts, leading to the emergence of theory. Thus the two approaches "reflect different ways of shifting between data and concepts" (Yin, 2011, pp. 93-94). Themes thus generated can be organisational (broad topics), substantive (descriptions emerging from the data and related to the broad topics identified) and theoretical (derived from concepts embedded in the theory being applied by the researcher) (Maxwell, 2008, pp. 236-238).

Maxwell's second type of strategies are connecting strategies. These involve viewing the data in context, and examining "for relationships that connect statements and events within a particular context into a coherent whole" (Maxwell, 2008, p. 238). Thus, throughout the analytical process, one is also looking for patterns and connections within the data: in this case, between the elements of the teacher professional development system and secondly, between the components of PCK.

The third group of strategies consist of analytic tools, memos and displays. These tools function to make thinking about relationships in the data explicit, as well as to represent the data in a reduced way so as to be able to view it as a whole picture (Maxwell, 2008, p. 239). Four of the data sets, the teacher contextual profile questionnaire, transcripts of audio-recordings, document analysis and the form for reflection and evaluation, resulted in analytic memos. For the final analysis, all four of the memos were cross-referenced.

In addition to these qualitative data analysis strategies, a small component of quantitative data analysis was undertaken through the utilisation of descriptive statistics as a means of summarising some of the data generated (O'Leary, 2004). In particular, some of the teacher contextual profile questionaire questions lent themselves to being summarised using descriptive statistics. Together, all of the above-mentioned strategies were used in the data analysis and are described in more detail below after the discussion of the phases of the analysis.

For this study, the first phase of the data analysis involved working with each individual data generation method to create an analytic memo. Different lenses and tools were used in this process. Thus the teacher contextual profile questionnaires were used to create Analytic Memo 1 (see Appendix G); the audio transcripts of the course sessions gave rise to Analytic Memo 2 (see Appendix H); the document analysis resulted in Analytic Memo 3 (see Appendix I); and, the course reflection and evaluation form was used to create Analytic Memo 4 (see Appendix J). The analysis process for each method is described below.

Phase 2 of the analysis is detailed in Chapter 4. In this phase of the analysis aspects of the different analytic memos are drawn upon to construct a narrative around the two sub-questions. The first part of Phase 2 thus related to Sub-Question 1: 'What are the elements and relationships between them in the *Fundisa for Change* teacher professional development system?' Borko (2004) identified the four elements of a professional development system as context, teachers, facilitator and the professional development programme (see Section 2.6). Data sources used to describe these elements of the course were teacher contextual profile questionnaires, course materials, observation notes and transcripts from the video-recording of the implementation of the course and transcripts of the audio-recordings of two of the four groups of teachers. The second part of Phase 2 related to Sub-Question 2: 'What are the amplifiers and filters affecting the development of teacher PCK in the *Fundisa for Change* teacher professional development system?' The amplifiers and filters identified in the Summit Consensus model (see Figure 2.1) include teacher beliefs, orientations, prior knowledge and context (see Section 2.3). Data sources for this phase of analysis were teacher contextual profile questionnaires, course activity outputs, transcripts of the audio-recordings of two of the four groups of teachers, and the reflection and evaluation forms.

3.5.1 Analysis of the teacher contextual profile questionnaire

Data generated by the different parts of the questionnaire served different purposes. Demographic and biographical information about the teachers was collected as background information and was summarised in table format. Information about teachers' beliefs, attitudes and orientation to teaching and learning was predominantly established from the questions from Luft and Roehrig's (2007) Teacher Beliefs Interview tool and, to a lesser degree, from the TALIS. For some of these questions, responses were also summarised using descriptive statistics such as frequencies to enable large amounts of data to be represented visually. The information from these sources was used to identify the amplifiers and filters that teachers might apply during the course. The teachers' responses were allocated to Luft and Roehrig's five belief categories detailed in Table 3.9 below, forming a continuum from teacher- to learner-centred beliefs, and coded according to the belief question maps provided by Luft and Roehrig (2007, pp. 57-63). An example of such a belief mapping is given in Figure 3.1 below. This enabled belief mappings to be made for individual teachers as well as across the group.

Table 3.9 Belief categories and descriptions (Luft & Roehrig, 2007, p. 54) with codes

Category	Description	Code
Traditional	Focus on information, transmission, structure, or sources	TRAD
Instructive	Focus on providing experiences, teacher-focus, or teacher decision	INST
Transitional	Focus on teacher/learner relationships, subjective decisions, or affective response	TRAN
Responsive	Focus on collaboration, feedback, or knowledge development	RESP
Reform-based	Focus on mediating learner knowledge or interactions	REFB

Information about the context in which teachers teach science, and information about their learners and the social context of the learners, were collected using questions adapted from both the TALIS and the original *Fundisa for Change* reflection and evaluation form (see Section 3.3.1). The TALIS 2013 Technical Report (OECD, 2014b) that details the development of the survey, its methodology and analysis, the 2013 TALIS Results report (OECD, 2014a) and the OECD special report titled Teaching Practices and Pedagogical Innovation: Evidence from TALIS (Vieluf, Kaplan, Klieme, & Bayer, 2012), were used to help with the question selection and data analysis. The responses to all the sections of the contextual profile questionnaire were also scanned for emergent patterns of similarity and difference, and themes and then sorted to form an analytic memo (see Appendix G). The main themes and sub-themes in the memo are detailed in Table 3.10 below.

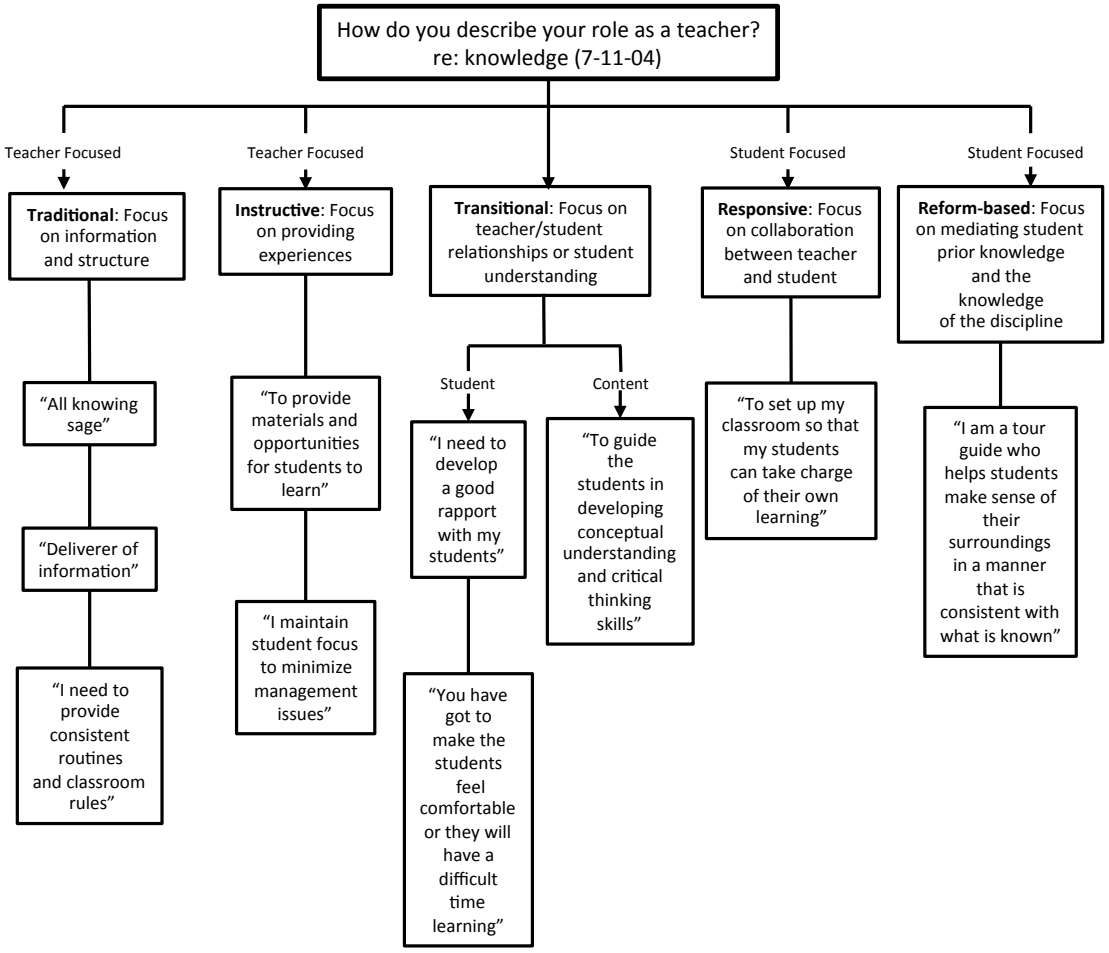

Figure 3.1 Mapping of the knowledge belief question 'How do you describe your role as a teacher?' (Luft & Roehrig, 2007, p. 58)

Table 3.10 Theoretical and substantive themes from Appendix G Analytic memo 1 of teacher contextual profile questionnaire

Appendix G: Analytic memo of teacher contextual profile questionnaire	
Theoretical themes	**Substantive themes**
Components of PCK (see Section 2.4): Pedagogical knowledge • Active learning • Group work • Practical work Curricular knowledge • CAPS Knowledge of Learners • Relate to content/ relevance • Abstract content Content knowledge Assessment knowledge	**Amplifiers and filters (see Section 2.3):** **Teacher context** Learner characteristics • Age of learners, • Language of learners • Motivation of learners • Learner self-regulation Resources **Teacher beliefs** Teacher beliefs about learning

3.5.2 Analysis of the observation notes from the video-recording

The use of the observation notes for analysis, was threefold. All three of the uses relate to answering aspects of Sub-Question 1: What are the elements and relationships between them in the *Fundisa for Change* teacher professional development system? The focus in the analysis of the observation data was on identifying broad themes as well as on connecting strategies.

Firstly, the observation notes were used to identify what the facilitator was doing during the course. The observations thus provided a means to describe my role within the professional development system, looking specifically at the relationship between myself and teachers and the characteristics of teacher professional development. The role of the facilitator addresses one of the aspects of the professional development system.

Secondly, the observation notes described the course context, content and proceedings. This allowed for a comparative analysis to be made between the *Fundisa for Change* course as described in the *Introductory Core Text* and the course as enacted by the facilitators. Furthermore, this enabled identification of the amplifiers and filters that had been applied by the facilitators when making decisions about what to select from the *Introductory Core Text* for the course enactment.

Thirdly, the observation notes were used to describe what the teachers were doing during the course. In this way the observation notes enabled description of how the *Fundisa for Change* course supported the development of the teachers' environmental PCK. This enabled an understanding of the nature of the opportunities offered by the course for teachers to develop their PCK and in particular, their environmental PCK.

3.5.3 Analysis of the transcripts of the audio-recorded group work

The analysis of the transcripts related to answering all three sub-questions. The conversations in the group discussions were examined to identify the topic under discussion, summarising sections of conversation in this way. After this was completed, topics not relevant to the course were discarded. Discarded topics were mostly personal in nature.

From the remaining segments, those where teachers "collaboratively produce sense within talk-in-interaction" (Koschmann, 2013, p. 150) were selected. According to conversation analysis research, "knowledge productive 'learning' conversations are constituted by a progressive discourse … and an informed participation" (Tillema, van der Westhuizen, & van der Merwe, 2015, p. 15). Typically these conversations would involve a shared task with willing teachers instructing each other in turns with others listening attentively so that they would be able to paraphrase or elaborate on what was said in their turn (Koschmann, 2013).

The selected segments of conversation were used to assist in identifying the ways in which the *Fundisa for Change* course supported the development of teachers' PCK, in particular environmental PCK, as well as in identifying what PCK, environmental or otherwise, emerged from participation in the course. These discussions were used in answering both sub-questions. The transcriptions were analysed for emergent themes (see Table 3.11) relating to components of PCK and pedagogical reasoning, as well as for themes that related to the idea of amplifiers and filters (see Table 3.11) from the Summit Consensus Model detailed in Chapter 2. Evidence of discussions relating to identified themes were organised in an analytic memo (see Appendix H).

Table 3.11 Theoretical and substantive themes from Appendix H Analytic memo 2 from group discussion transcripts

Appendix H: Analytic memo of group discussion transcripts	
Theoretical themes	**Substantive themes**
Components of PCK (see Section 2.4): Assessment knowledge • Cognitive levels of assessment • Strategy Content knowledge • Content representations Curricular knowledge Knowledge of learners • Prior knowledge of learners Pedagogical knowledge • Teaching strategies	**Amplifiers and filters (see Section 2.3):** **Teacher context** Context of curriculum • CAPS focus on assessment • Time Teacher classroom context • Context • Resources and class size Learner characteristics • Motivation of learners **Teacher beliefs** Teacher beliefs Teacher misconceptions **Themes related to characteristics of teacher professional development**: Group work Content knowledge of facilitator

3.5.4 Document analysis

1. Analysis of the participant outputs

Outputs from course activities were mainly group efforts, the only exception being the lesson plans, which were completed individually. The course outputs (see Table 3.5 above) were examined for themes being raised, as well as for evidence of the development of components of PCK. Two of the outputs warranted more in-depth analysis: the content representations and the lesson plans. The analysis of these outputs is described in more detail below.

Analysis of the completed CoRe templates

CoRe templates were completed by groups of teachers organised according to the grade that they teach. Each of the questions in the CoRe 'Big Ideas' activity (Activity 7) was related to one of the components of topic-specific PCK (see Table 3.6 above). The teachers' responses were described in terms of the criteria in the rubric descriptors. In this way the rubric was used as an analytic tool. The PCK rubric was originally developed by Park, Chen and Yang in 2008 (Park, Jang, Chen, & Jung, 2011) but adapted and elaborated by Mavhunga (2012) and Mphathiwa (2015). I have adapted the teaching strategies component of the rubric to include the PCK component of assessment strategies (see Appendix M). The completed CoRes of the two audio-recorded groups is presented in Section 4.2.1.

Lesson plan analysis

As with the CoRe, the lesson plans of the members of the two recorded groups are discussed with respect to evidence of pedagogical reasoning (See Section 2.5) and the components of PCK (See Section 2.4). The lesson plans were for the Grade 6 topic of 'Ecosystems and food webs' and the Grade 7 topic of 'Variation'. The lesson plans were analysed for evidence of the application of components of PCK.

2. Analysis of the Fundisa for Change course materials

Relevant extracts pertaining to the course contents and objectives were selected and highlighted electronically, then sorted into Analytic memo 3 (see Appendix I). This memo

was used to establish the context of the course, supporting Sub-Question 1. The course content and objectives were also used for comparison with the enacted course as a means of highlighting the amplifiers and filters applied by the facilitator in selecting material for the course.

3.5.5 Analysis of the course reflection and evaluation form

Comments in the reflection and evaluation form were categorised using the theoretical themes of the components of PCK. Also emerging from this data set were several substantive themes including those around characteristics of teacher professional development (see Section 2.5.2) and themes relating to amplifiers and filters (see Table 3.12 below). These themes were then used to create Analytic memo 4 (see Appendix J).

Table 3.12 Theoretical and substantive themes from Appendix J Analytic memo 4 from reflection and evaluation form

Appendix J: Analytic memo from reflection and evaluation form	
Theoretical themes	**Substantive themes**
Components of PCK (see Section 2.4): Assessment knowledge • Purpose of assessment Content knowledge • Environmental learning Curricular knowledge Knowledge of learners • Prior knowledge of learners Pedagogical knowledge • Teaching strategies • Planning for teaching • Purpose of activity **Core characteristics of teacher professional development (see Section 2.6.2):** Active participation Content focus	**Amplifiers and filters (see Section 2.3)** **Teacher context** Access to resources **Teacher beliefs** Teacher beliefs about learning Teacher learning **Themes related to characteristics of teacher professional development**: Group work Time for course Content knowledge of facilitator Resources for course Relevance of course to teachers needs Relevance to learners Teacher learning

3.6 Qualitative and quantitative validity considerations

Validity in both quantitative and qualitative studies refers to ensuring that the researcher "has properly collected and interpreted … data, so that the conclusions accurately reflect and represent the real world … that was studied" (Yin, 2011, p. 78). Continuous efforts to ensure validity and reliability are important in both types of research as a means of ensuring the credibility and trustworthiness of the research although the considerations through which validity is achieved in each type may differ considerably (Cohen et al., 2007). From a quantitative perspective, validity would be bounded by, among others, ideas such as controllability, predictability and sample randomisation (Cohen et al., 2007, p. 134). From a qualitative research perspective, different kinds of validity are "derivative from the kinds of understanding gained from qualitative enquiry" (Maxwell, 1992, p. 281). Maxwell (1992) defined descriptive validity as meaning an endeavour to objectively describe events in a factual and accurate way (p. 285). In this research, this type of validity was particularly applicable to giving an account of the course and the group discussions. The procedure of providing thick, rich description of the event and the group interactions within it aimed to create credibility and was equally applied to the interpretive understanding to establish interpretive validity.

Interpretive validity refers to the *meaning* that is being ascribed to the accounts of the participants' discussions and actions. "Interpretive accounts are grounded in the language of the people studied and rely as much as possible on their own words and concepts" (Maxwell, 1992, p. 289) as well as the context in which they arose (Yin, 2011, p. 20). In this way, "the language is valued as the representation of reality" (Yin, 2011, p. 20).

The primary procedure used to establish interpretive validity is that of triangulation. Triangulation is defined as "a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study" (Creswell & Miller, 2000, p.126). Thus for each of the sub-questions, multiple sources of generated data were considered (see Table 3.1 above) involving a selection from contextual profiles, course outputs, video- and audio-recordings and reflection and evaluation forms as a means of triangulating the data. In this way, the variety of data sources used in the research served to cross-check and verify data and to provide interpretive validity and dependability of

findings (Botes, 2003, p. 183). The triangulation technique enabled the data description to "explain more fully, the richness and complexity of human behaviour" (Cohen et al., 2007, p. 141), allowing greater confidence that the data generated did not present a biased viewpoint.

Maxwell (1992) also identified generalisability as another type of validity. Expanding on this idea, Botes (2003) identified two ways in which generalisability can be achieved for qualitative research: firstly, through inductive argument based on saturated data, and secondly, through thorough description enabling others to decide on the transferability of findings (p. 183). The aim of my research was a degree of transferability, foremost but not limited to, the other *Fundisa for Change* teacher professional development courses. To this end, the research involved detailed and in-depth description to assist with "inductive generalisation" (Botes, 2003, p. 183) as a means to making it translatable and comparable to other situations. Care has been taken to describe the context of the study in depth to enable other researchers to contemplate transferability.

A final consideration is evaluative validity, where a judgement may be made, and the researcher needs to monitor that his/her own biases do not affect the research. Cohen et al. (2007) wrote "that researchers should acknowledge and disclose their own selves in the research, seeking to understand their part in, or influence on, the research" (Cohen et al., 2007, p.171). As a facilitator of the *Fundisa for Change* courses, I was able to reflect on the course. My involvement in the *Fundisa for Change* programme had begun two years previously with my authoring of one of the resources, the *Teaching Climate Change* Senior Phase Natural Science book. Since then, I had been involved in the implementation of several of the *Fundisa for Change* courses. The position of facilitator-and-researcher does have other implications in that one would need to be not only critically reflective, but also reflexively aware of one's influence on the research (Cohen et al., 2007). This reflexivity on the part of the researcher is another means to establish validity. According to Maxwell (2008), the experiential knowledge of the researcher can be a source of valuable information regarding perceptiveness and checking for validity rather than the more traditional view of seeing the researcher as a source of bias (p. 225). However, the researcher's views, experiences, assumptions and beliefs do then need to be made explicit, as the researcher's subjectivity needs to be acknowledged as "an inevitable feature of the research act" (Walford, 2001, p. 9). To this end, the relevant aspects of my and my co-facilitator's life experiences are

summarised in Section 4.4.1 with additional biographical information captured in more detail in Appendix B in the form of researcher identity memos.

3.7 Ethics

Ethical behaviour in qualitative research involving the study of people refers to the careful consideration of the rights of the people being researched. The participants' rights and dignity need to be considered at all times and any negative effects of the research anticipated and counteracted (Cohen et al., 2007, pp. 58-59). In this study, ethical considerations were formally addressed through the process undertaken for ethical clearance which detailed aspects such as informed consent, confidentiality and potential harm to participants. No potential harm, physical or psychological, to participants was anticipated for the study. Participants attended the course in their usual venues and at the same times as the other ACT classes, ensuring no disruption to the ACT schedule. The other considerations are discussed in more detail below.

3.7.1 Ethical clearance

Initial ethical clearance for my research was given by Rhodes University (see Appendix A1). As the participants in my research were teachers studying at the University of Cape Town, I also needed to obtain ethical clearance from the Humanities Faculty Research Ethics Committee, Humanities Postgraduate and Research Office, University of Cape Town (see Appendix A2) as well as the Director of the School of Education (as detailed in Section 3.2.2 above).

3.7.2 Informed consent

Once all the ethical permissions were in place, I met the teachers as they registered for the 2016 academic year. Registration provided me with the opportunity to address the teachers and explain the proposed research to them as well as the details of a consent form developed for research purposes (see Appendix A3). As stated by Cohen et al., "the principle of informed consent arises from the subject's right to freedom and self-determination" (Cohen et al., 2007, p. 52). Teachers, after having had the study explained to them, were asked if they

would like to "knowingly and voluntarily" (Cohen et al., 2007, p. 52) complete a consent form in which the research protocol was carefully explained, including the purpose of the research, the rights of the participant, and a guarantee of the use of pseudonyms to retain anonymity. I also obtained permission to use teachers' assignments, tests and outputs from course activities. All the participating teachers gave consent for the audio-and video-recordings to be used for the research, as well as the outputs produced during the course. One teacher expressed a wish not to be interviewed and this was respected.

Although the intention was that the consent forms would be taken away to be read more carefully, the teachers decided to sign them and hand them back immediately. They appeared well-disposed to the idea of participating in the research. Unbeknown to me, there were two teachers in the group that had taken part in workshops/courses I had held before and our greetings did much to create a sense of familiarity and trust – I was 'known' and not a complete stranger. Thus I obtained informed consent from all the participating teachers before beginning the study. Every effort was made to treat all participants equally, with respect and consideration.

In addition to the teachers, consent to participate in the research was also obtained from the ACT course convenor, Nomvuyo Mgoqi (see Appendix A4). Nomvuyo was the lecturer for this group of teachers in their first year of study and was present during all of the *Fundisa for Change Teaching Life & Living* course sessions.

3.7.3 Confidentiality

All data collected was coded in such a way as to ensure confidentiality and privacy. The questionnaires and interviews, in which research participants were asked to express personal opinions regarding the training and their learning, were also coded to protect the identity of the individual. All participants have been given pseudonyms to maintain anonymity. As neither race, nor culture of participants was being examined with respect to the development of PCK, it was decided to allocate everyone isiXhosa pseudonyms. In reality there were four different home languages represented within the group, being isiXhosa, Shona, English and Afrikaans. However, all the teachers were proficient in English, the medium of instruction of the course.

3.8 Summary

This chapter has highlighted how the research has been designed in order to answer the research question of how the development and emergence of environmental PCK is supported and constructed in the *Fundisa for Change* teacher professional development course. The research took the form of a descriptive case study with in-service teachers as participants. Data generation took place over five contact sessions of three hours each and included a contextual profile questionnaire, course outputs and assessment tasks and a reflection and evaluation form. The analysis of these data sources has been described as well as the employment of strategies to ensure validity, reliability and ethical conduct. The following chapters present and discuss the data.

Chapter 4 Data analysis

4.1 Introducing the data as elements of the professional development system

This chapter relates to Phase 2 of the analysis (see Section 3.5). The chapter draws on the analytic memos related to answering Sub-Question 1: What are the elements and relationships between them in the *Fundisa for Change* teacher professional development system? and Sub-Question 2: What are the amplifiers and filters affecting the development of teacher PCK in the *Fundisa for Change* teacher professional development system?

The chapter takes its structure from Borko's (2004) description of the elements of a professional development system (see Section 2.5) with the last element, the all-encompassing context, being infused throughout the preceding three:

> The professional development (PD) program;
> The teachers, who are the learners in the system;
> The facilitator, who guides teachers as they construct new knowledge and practices; and
> The context in which the professional development occurs.
>
> (Borko, 2004, p. 4)

In the following section, the *Fundisa for Change Teaching Life & Living* course is described in terms of the context out of which it arose followed by how it was presented to the teachers. Detailed accounts of each of the five sessions are given. Section 4.3 introduces the teachers and explores the beliefs and orientations, prior knowledge and contexts that they bring with them into the professional development system. The amplifiers and filters identified are presented according to themes that emerged from the analytic memos in the Phase 1 analysis. Lastly, the facilitators are introduced and our influence on the enactment of the professional development system is presented.

4.2 The *Fundisa for Change Teaching Life & Living* Teacher Professional Development Course

As noted in Section 1.2, the *Fundisa for Change* Programme arose as a national response to support in-service teachers as they navigated the environmental knowledge introduced in the CAPS. The expected outcomes of the course, as described in the *Fundisa for Change* documentation, relate to the following four knowledge areas:

- *Subject Knowledge and Learning (Theory):* Show improved understanding of environment and sustainability subject knowledge in the context of a specific Subject and Phase.
- *Pedagogical Knowledge and Learning (Practice):* Show ability to use appropriate teaching methods and assessment approaches for a specified subject knowledge, skills and values
- *Situated Knowledge and Learning (Context):* Relate subject specific environment and sustainability content knowledge to broader issues and contexts
- *Practical Knowledge and Experience (Work Experience):* Design, develop, implement and reflectively review a lesson plan / sequence of lesson plans relevant to an environmental and sustainability content focus in a particular Subject and Phase/ Grade. (Fundisa for Change Programme, 2014, p. 2)

These outcomes are integrated in and mediated by the *Fundisa for Change* course materials with their focus on: "knowing your subject; improving your teaching practice; and, improving your assessment practice" (O'Donoghue, 2013, p. 6).

The structure of this particular *Fundisa for Change* course was unusual in that the course is typically run over three days as a South African Council for Educators (SACE) accredited Short Course whereas the *Fundisa for Change Teaching Life & Living* course as presented to this group of teachers, consisted of five sessions each three hours long. Because of the lecture format for this iteration, the course inputs were spread out over a longer period of time. The first three sessions were spread over two weeks. The last two sessions took place three months later and concluded the course. At the first session, teachers were given the Teacher Contextual Profile Questionnaire to complete. After the third session, teachers completed the Course Reflection and Evaluation Form. For all the sessions, teachers worked in small groups of between three and five people. There were always two facilitators present: myself, and my colleague, Nomvuyo Mgoqi, who was the ACT course convenor (see Section 4.4 below).

The *Fundisa for Change* Programme has many courses on different environmental topics, but the *Fundisa for Change Introductory Core Text* (Fundisa for Change Programme, 2013) is common to all the courses and as such the teaching of the *Introductory Core Text* activities along with the assignment tasks were the focus of the study. A summary table outlining the topics and activities of the five sessions is given in Table 4.1 below.

Table 4.1 Topics and activities for the five sessions of the Fundisa for Change Teaching Life & Living course

	Topic	**Activity and brief description**
Session 1	A Changing Environment Know Your Subject	*Activity 1: Movie* As part of the activity, teachers watched a short movie on biodiversity. After completing the activity, teachers discussed the activity structure in terms of the purpose of each of the instructions. *Activity 2: Build a better world* Groups defined key social justice and environmental sustainability words, relating them to their teaching *Activity 3: Life & Living: Ecology in the CAPS* In groups, teachers built a mind map using keywords for Life & Living ecology topics from Grade 4 through to Grade 8
Session 2	Improve your teaching practice Core concepts, pedagogy and assessment	*Activity 4 Exploring teaching methods* Referring to a list of teaching practices, teachers indicated the frequency with which they might use each practice *Activity 5 Evaluating the sequence of methods used in a programme of learning* Groups identified the teaching methods used in a series of lessons on a topic *Activity 6 The water cycle* Groups described the phase changes in the water cycle and then drew a diagram to trace a water drop through Earth's spheres. Human impact was also added on to the diagram. The groups assessed each other's diagrams using a rubric and gave written feedback to the groups.
Session 3	Planning assignments	*Activity 7 Big ideas and lesson planning* Groups completed a CoRe (Content Representation) template for an environmental topic, followed by individually drawing up a lesson plan.
Session 4	Improve your assessment practice	*Activity 8 Assessment discussion* Teachers discussed questions about the definition and role of assessment in CAPS *Activity 9 Assessment vignettes* Teachers discussed a series of four vignettes illustrating classroom formative and summative assessment practices and answered questions about the assessment strategies used.
Session 5	Assessment and CAPS	*Activity 10 Assessment of environmental learning in CAPS* This activity used the revised Bloom's Taxonomy Tables to identify the knowledge and cognitive dimensions of CAPS assessment objectives and process skills.

The activity descriptions were compiled by drawing on the following data sources:

- the session observation forms which refer to sections of the video recordings of the sessions (S1OBS: VT1 – S5OBS: VT3)
- the session transcripts capturing the facilitator transactions (TM1 – TM5)
- the PowerPoint slides used during the training (S1PPT – S5PPT)
- the transcripts of the group discussions (TAT1G1 – TAT5G4)
- the *Introductory Core Text* (Fundisa for Change Programme, 2013)
- the groups' outputs during the course activities (see Table 3.5)
- the teachers' reflection and evaluation forms (REF)

The activities were not always presented exactly as described in the *Introductory Core Text*. The differences between the activities recommended in the core text and the actual activities as conducted in practice, are described later in Section 4.4.2 and Appendix O. Described here, in the following section, is the detail of the activities as presented to the teachers during the course sessions. For each activity, the purpose as understood by the facilitators from the *Introductory Core Text* and course outcomes is given, followed by bullet points detailing the actions of the facilitators and teachers during the activity including any teacher feedback received at the end of the activity. If the activity reflections were from the reflection and evaluation form, they are included under a separate heading at the end of the activity description. Following the activity accounts are descriptions of the professional development characteristics that emerged from the data as impacting on the growth of teacher PCK.

4.2.1 Course activities

Activity 1 Movie

The design of this activity incorporated two purposes: Firstly, to explain biodiversity in terms of the key concepts of ecosystem diversity, species diversity and genetic diversity, and secondly, to model the teaching strategy 'listening with intent'. The specific purpose here was to reinforce the 'intent' part by making it more explicit and for teachers to discuss, in the second part of the activity, the impact of the instructions on their subsequent learning, as well as how they would implement the activity in their context. The activity had the following steps:

- Prior to watching the movie, teachers were told that after the movie, they would have to write down as many facts about biodiversity as they could remember, first individually and then in their groups. The group discussions gave teachers the opportunity to work with and think about the content knowledge presented in the movie. An extract of a discussion by one of the groups of teachers is:

> **Viwe**: … biodiversity has three main categories – ecodiversity, species diversity, genetic biodiversity and then just to summarise what I got out of this, is Earth is a big intertwined web of biotic and abiotic components focused on survival
> …
> **Mabhuti:** What I see is the Amazon is an example of life process. So if you remove a single species the ecosystem falls apart but if you have other ecosystems where all the species are dependent on each other so if you remove one, just a single …
> **Akhona:** Like coral
> **Mabhuti:** Coral is an example. The whole ecosystem collapses so that can be a
> **Mlondolozi:** Not to mention the interdependence
> **Akhona:** Yes
> **Mlondolozi:** And they are depending on each other, depending on the food. And also humans out of the environment. That's what I remember.
> (TAT1G1, //29 – 47)

- Groups gave feedback with contributions summarised on the board.
- The teachers gave feedback on the strategy of providing clear instructions at the outset of the activity, to explain the criteria for the successful completion of the activity. An extract of this discussion is given below:

> **Akhona**: It was really useful to be given that in the beginning because immediately my attention was then drawn to the outcome
> **Mabhuti**: Ja it was. You knew then what was going to be expected.
> ….
> **Viwe**: Ja it was nice and to know what was going to be expected. I think it's important especially at a senior level and even at a junior level for kids to know what it is that they're going to adventure upon.
> (TAT1G1, //106-108, 114-115)

- Teachers discussed in their groups, the practicalities of implementing the activity in their own contexts. In the discussion extracts below, a teacher commented on taking time to first establish learner prior knowledge before later summing up the group discussion:

> **Viwe**: What I do think could have possibly been before the movie, is just an introductory discussion on biodiversity. Not to tell the learners what it is.

Akhona: Yup
Viwe: But just to get reports and perhaps even their misgivings on what they think biodiversity is. (TAT1G1, //116-119)

Viwe: So perhaps do it as you said. Have the short introductory discussion, show the movie without giving them instruction so they can watch it and just view it … Then after that giving them that, make individual notes, after which you show the video again. Now they know this is what I was supposed to listen to. (TAT1G1, //141-144)

Another of the groups spent time making sense of the activity in terms of the five E's (Engage, Explore, Explain, Elaborate and Evaluate) instructional model based on a constructivist approach to learning that they had been exposed to in a previous part of their training (TAT1G2, //62-64).

- Groups gave feedback that was summarised on the board. The first group talked about how they would adapt the structure of the activity by making suggestions about having learners watch the video twice as per the above dialogue. The second group discussed the process of building common understanding through group work, saying: "We have come together as a group – this one brought this thing, this one brought this thing, and we come up with one common thing" (TM1, //223-224). The third group reported on how the lesson was learner-centred and that the instructions gave focus (TM1, //236-238).

Teacher reflections on *Activity 1 'Movie'*

In the course evaluation and reflection form, teachers were asked to reflect on both the movie activity (Q1a) and the activity as an example of an active listening strategy (Q1b). Roughly a third of the teachers commented on the impact of the discussions on their learning, making comments such as:

> "Sharing ideas during the active listening process made me aware of the different interpretations to a topic, and how all the idea can be amalgamated to form a bigger picture" (Teacher B, REF, Q1b).
>
> "Being able to reflect and listening to reflections gave clearer insight into the clip" (Teacher D, REF, Q1b).
>
> "The discussion opened up the mind from the set ideas gained while watching and others came up with their views" (Teacher K, REF, Q1b).

A third of the teachers related the activity to how their own learners would potentially react if they used the activity in their class:

> "Learners could relate to the movie clips when [they] are being assessed which means that will be easy for them to answer any questions" (Teacher P, REF, Q1b).
>
> "Effective approach to learning. Keeps learners focused. Learners retain most of the concepts. Not boring, but stimulating" (Teacher J, REF, Q1a).
>
> "This part encourages all learners to be actively involved (listening attentively) so as to be able to respond to questions. Very useful" (Teacher A, REF, Q1b).

One teacher had tried the activity out with a class and wrote: "I found it to be so useful in my introduction to Biodiversity in Grade Seven" (Teacher M, REF, Q1a). Another talked of transferring the teaching strategy to a new context and wrote: "all this was new to me yet very informative and useful because I will use the same method when teaching *Earth & Beyond*" (Teacher O, REF, Q1a). A quarter of the teachers reflected on their understanding of the content:

> "The movie was a true reflection of a habitat that consists of the variety of living organisms and interdependency" (Teacher L, REF, Q1a).
>
> "It was a video which depicted realities in our everyday life and how different species interact" (Teacher C, REF, Q1a).
>
> "The movie helped to open up an understanding of biodiversity" (Teacher K, REF, Q1a).

Lastly, almost two-thirds of teachers commented on the positive effect of receiving the instructions at the start of the activity:

> "Given the instructions first, [enabled] me in knowing what was expected of me" (Teacher M, REF, Q1b).
>
> "This allowed me to focus more attentively on the video" (Teacher H, REF, Q1a).
>
> "Teachers listened attentively because they knew that questions will be asked at the end of the movie" (Teacher O, REF, Q1b).
>
> "It set the foundation for the lesson. Thus conveying the lesson's expectations" (Teacher B, REF, Q1a).

Activity 2 Build a better world

The purpose of this activity was to encourage teachers to think about the broader concepts of the environment and society in the future. The terms defined in this activity were also linked to the general aims of the South African curriculum, which are based on the principles of social transformation, human rights, inclusivity, environmental and social justice (South Africa. DBE, 2011, pp. 4-5). The activity steps were:

- Working in groups, teachers were asked to define the words: Equity; Sustainability; Resilience; Adaptation; and, Transformation. Teachers also had to provide an example of a social practice that expressed the meaning of the word and explain the relevance of these words to education. Teachers built up a common understanding of the words as illustrated in the sample extract below where teachers are discussing the meaning of 'resilience':

> **Akhona**: Yes resilience is to
> **Viwe**: The power or ability to return to the original form
> **Akhona**: Return or to stand fast. Overcome obstacles
> **Mlondolozi**: Or challenges
> **Akhona**: Or challenges, yes.
>
> (TAT1G1, //304-308)

- Teachers gave feedback on their discussions. Below is an example of a group's final definition:

> Equity - the definition is equal or enough resources for everything and everybody. That's how we looked at it. In social practice we looked at it as a man and woman getting the same opportunities. And then it came to relevance to education - allowing everyone to have the same opportunities.
>
> (Group 4 teacher, TM1, //386-389)

Teacher reflections on *Activity 2 'Build a better world'*

On the course reflection and evaluation form, nine of the teachers reflected on how their own learning and understanding was developed as a result of this activity with comments such as:

> "Good for my professional development and understanding as there were shared ideas on these terms and misconceptions were addressed" (Teacher A, REF, Q2).
>
> "The terms were intertwined and found that there is a thin layer which separates them" (Teacher C, REF, Q2).

> "Constructive activity as thoughts, ideas and misconceptions were shared and could be cleared" (Teacher D, REF, Q2).
>
> "It broadens our minds because we have to think back and differentiate the definitions" (Teacher I, REF, Q2).
>
> "I became able to differentiate between the words" (Teacher P, REF, Q2).
>
> "Awareness of or about real life challenges and expectations" (Teacher L, REF, Q2).

Although the focus in this activity was on teacher conceptual development, teachers recognised the discussion of definitions of words as a useful generic teaching strategy for language development, making comments such as:

> "It drives learners to use dictionaries (if allowed) – thereby developing their vocabulary or term concept building and understanding" (Teacher H, REF, Q2).
>
> "Learners must be encouraged to be familiar with meanings of words & relate these words to their day to day living in the world" (Teacher N, REF, Q2).

Activity 3 Life & Living: Ecology in the CAPS

The goal of this activity was to trace the developmental progression of environmental topics through the *Life & Living* topics in the intermediate and senior phase Natural Sciences CAPS, thereby developing curricular knowledge. The activity had the following steps:

- The introduction for this activity followed the topic "Know your subject" (Fundisa for Change Programme, 2013, p. 6) by taking as the starting point, the CAPS principles and the pillars of Education for Sustainable Development.
- Teachers were given keyword lists created by the facilitators and asked to cut them up and create a mindmap to track concepts from Grades 4 – 7. Typical extracts of conversation where teachers are building their understanding of the conceptual progression are given below. In the first extract, teachers are trying to work out where the concept of a 'species' is first introduced:

> **Viwe:** Isn't species a part of grade 7?
> **Akhona:** Ja it is
> **Viwe:** Species is a part of grade 6 as well isn't it?
> **Akhona:** Oh, variation is a part of grade 7. You right, sorry. Species, no it's variation.
> **Mabhuti:** And then species?

Akhona: And then species? There, okay? So that would be grade 6? grade 5?
(TAT1G1, //850-855)

In the following extract, teachers are coming to realise the extent of the overlap and progression between grades for some concepts:

Mabhuti: Invertebrates can also come in here also
Akhona: Are you sure?
Viwe: Yes, in grade 5 they do vertebrates.
Akhona: Because we do vertebrates in grade 7.
Mabhuti: I know that. In grade 4 they do herbivores, carnivores, omnivores
Akhona: You see now? This is all grade 7!
(TAT1G1, //990-995)

Akhona later comments to the facilitator: "I'm horrified. The whole of Grade 7 is sitting in these earlier grades. Why don't these children know anything? …. I need to get through this stuff in a week, not in three weeks" (TAT1G1, //1188-1189, 1193-1194).

An illustrative example of a mindmap produced by one of the groups is shown in Figure 4.1 below.

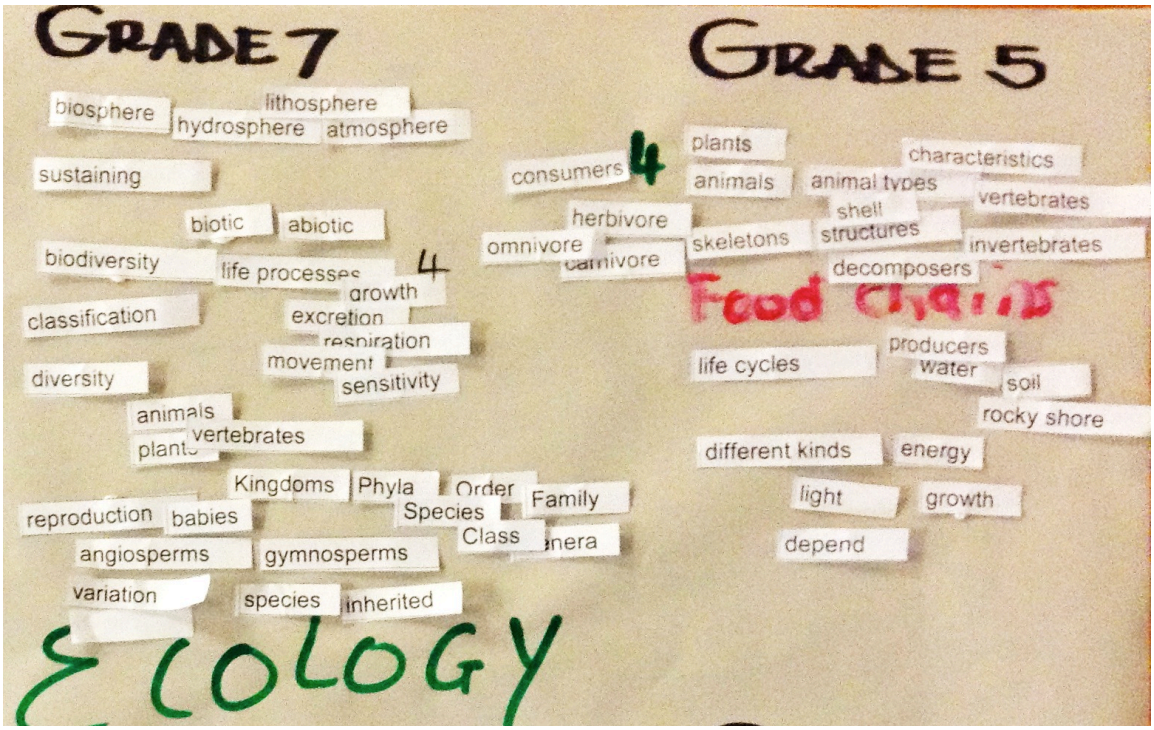

Figure 4.1 Section of a group's mindmap (G1MM)

Teacher reflections on *Activity 3 'Life &Living: Ecology in the CAPS'*

Nine of the 15 teachers' reflections on this activity, were about how the activity enabled them to see the links between concepts across the grades, with comments such as:

> "It showed the link across grades, thus making it helpful to trace the learner's expected prior knowledge" (Teacher B, REF, Q3).
>
> "concepts developed spirally as they touch on different aspects per grade" (Teacher C, REF, Q3).
>
> "The activity was so good since one could follow and see the interdependence and interactions of concepts. How concepts link to each other" (Teacher J, REF, Q3).
>
> "It was mindblowing to see the progression and link across the grades. So much is over taught!" (Teacher M, REF, Q3).

Two of the comments on this activity reflected on the usefulness of mind-mapping as a general teaching strategy for content representation:

> "The activity was so good since one could follow and see the interdependance and interaction of concepts. How concepts link to each other" (Teacher J, REF, Q3).
>
> "This was very good because it showed me that from the mind-map there are lot of other lessons that you can relate to other subjects as well" (Teacher P, REF, Q3).

A further two comments reflected on the usefulness of mind-mapping to scaffold learners' learning:

> "Learners can make the summary of the topic by assisting each other and write down a mind map in groups, then compare their charts by looking at important terms omitted by other groups" (Teacher O, REF, Q3).
>
> "It would also assist those learners who are very slow; thereby unpacking big words into simple embedded words" (Teacher H, REF, Q3).

Activity 4 Exploring teaching methods

The purpose of this individual activity was to create an awareness of, or remind teachers of, the wide range of teaching methods that are possible to use. The activity steps were:

- Teachers were given a summary list of short descriptions of the methods given in detail in the *Methods and Processes to Support Change-Oriented Learning* booklet (Rosenberg, O'Donoghue, & Olvitt, 2013) on which they recorded if they used a method 'hardly', 'seldom' or 'often'.
- This was followed by a brief feedback discussion (TM2, //213-237). Two teachers gave feedback focused on explaining why they no longer use a variety of methods, citing the assessment focus of the curriculum as the reason, as evidenced in these comments:

> "… my comment when I was reading this was oh my word, I'm sitting on 'hardly' everywhere and then quite rightly so, a comment … that Lwazi made that we teach for the assessments … very sad but reality … now when you reflecting on this, you find yourself thinking: 'Gee I'm not doing this [these methods] anymore and its because you're so focussed on the end point" (Akhona, TM2, //218-227).

> "The curriculum has changed. The curriculum is so focussed on assessment rather than teaching of the content for the knowledge of the children … and giving the child knowledge or letting the child learn" (Lwazi, TM2, //229-233).

Teacher reflections on *Activity 4 'Exploring teaching methods'*

In their reflections on this activity, the majority of teachers mentioned what they personally had gained, referring either to what they had learned or how they would apply different teaching methods in the classroom.

> "I was able to see different methods of teaching environment learning" (Teacher E, REF, Q4).

> "As a teacher you get to explore different methods on integrating Ecology in your lessons and how to make the lessons more interactive using active learning" (Teacher F, REF, Q4).

> "That was very powerful. It would assist teachers to do their planning thoroughly - knowing what they actually aiming at" (Teacher H, REF, Q4).

> "Varying of teaching methods keeps learners engaged & the learning environment is kept conducive and exciting which helps learners grasp concepts" (Teacher N, REF, Q4).

Activity 5 Evaluating the sequence of methods used in a programme of learning

The aim of this group activity was to stimulate thinking about how different teaching methods can be used to serve different purposes. The activity had the following steps:

- Teachers were given examples of worksheets that illustrated different teaching methods and were then directed to the vignette in the *Introductory Core Text* (p. 12) that detailed the activities a teacher had given her class on water quality.
- Teachers identified and discussed the sequence of teaching methods used in the vignette, the goal of each method, and the teaching strategy used, recording these in a table. An example of a group's comments is given as a way of illustrating the understanding required to complete the activity: Group 3 (G3EM) identified the first activity as "Read with understanding a section in their textbooks on water quality as well as on water pollution and its effect" with the goal "Learners must understand the effect of water pollution" and as using the teaching strategy "Learners read with understanding".
- Teachers gave feedback on the activity. Comments arising during the class feedback varied from seeing the potential of using a variety of teaching methods to anticipating problems with implementation due to class size:

> "I think a lesson has to comprise of a diversity of teaching methods. You have to use different teaching methods … to come up with a lesson … so it at least becomes interesting to the learners as they are not … doing one thing" (Daluxolo, TM2, //639 – 645).
>
> "It reinforces the importance of those process skills" (Akhona, TM2, //652).
>
> "ushers them into [being] active participants of learning" (Thembani, TM2, //661-662).
>
> "I think these method would be … good but for our … number of learners in our classes it's going to be too hard" (Phumza, TM2, //673 – 674).

Teacher reflections on *Activity 5 'Evaluating the sequence of methods used in a programme of learning*

When teachers reflected on this activity, responses varied from direct comments about the learning such as "this taught me that each learning goal needs a relevant teaching method" (Teacher A, REF, Q5) to more general comments about the link between teaching method and purpose such as "that there are multiple ways to get to a specific target" (Teacher D, REF, Q5).

Activity 6 The water cycle

The aim of this group activity was: to develop the core environmental concepts of "The Earth as a system" and "Key life supporting processes"; and, to formatively assess work, using a memo and rubric, to give constructive feedback. The activity had the following steps:

- The activity was introduced as relevant for the CAPS Grade 9 topic of the Earth as a system.
- Groups were shown a drawing of the water cycle and asked to describe in a written paragraph the path of a drop of water through the cycle using the words: solid, liquid, gas, precipitation, condensation and evaporation (see G1WC(1) to G4WC(1) in Appendix K). The following extracts are examples to illustrate the water cycle knowledge clarification that occurred through the group discussions:

> **Lindiwe**: Okay. Water cycle. Where does it all start? With precipitation?
> **Zuko**: Doesn't it start with evaporation?
> **Lindiwe**: It starts with the water. The water in the sea, the sun shining down. Then up goes the water and it becomes …
> **Zuko**: So evaporation first, yes? So everybody decided? No? Heating and then sun …
> **Lindiwe**: But first the sun heats up the water and it evaporates
>
> (TAT2G4, //451-457)

> **Daluxolo**: When the clouds are full [of water] the clouds are going to be moved by the wind
> **Fezeka**: The wind blows the clouds
> **Buzwe**: To another area
> **Fezeka**: Mm mm
> **Buzwe**: Okay
> **Daluxolo**: This water vapour, it's warm right?
> **Buzwe**: Mm hm
> **Daluxolo**: And then it has to meet up with cold air
> **Buzwe**: Cold air
> **Fezeka**: Mm
> **Daluxolo**: The warm water vapour
> **Buzwe**: Warm water vapour meets
> **Daluxolo**: Meets with cold air
>
> (TAT2G3, //719-733)

- Teachers read their group's water cycle descriptions to the whole class.
- Groups were asked to draw a diagram showing the movement of water through Earth's systems: the pedosphere, hydrosphere, atmosphere and biosphere. Each different representation of the content stimulated much discussion and clarification of the content

as evidenced in the extracts below where groups are trying to relate the processes of evaporation and condensation to movement of water between the spheres:

Daluxolo: We say rain - the atmosphere - this is where water is leaving one of the spheres
Buzwe: Ja
Daluxolo: And going to the other
Buzwe: But then what is that? Like for instance the process. Its the operation
Daluxolo: Say?
Buzwe: Evaporation is the process, but what about to flow from gas back to water
Daluxolo: From gas to liquid?
Buzwe: To liquid
Daluxolo: That's condensation
Buzwe: Condensation
Daluxolo: Mm hm
Buzwe: So you can talk about condensing from there to there and you could specify evaporation

(TAT2G3, //971-982)

Zuko: The air condenses towards the ground because sometimes if it was hot during the day and then it becomes cold at night you find dew in the morning. So that air condenses to this (inaudible) subject to correction. Take an arrow here and then up here. That's condensation.
…
Lindiwe: And all of those from there to there you know it also goes from the pedosphere to the biosphere because the plants get their water out of the soil

(TAT2G4, //701-713)

- Teachers then added human impacts onto their diagrams. Below are two extracts from a discussion around human impacts:

Khuthala: It's pollution in water in the hydrosphere
Buzwe: What is it?
Khuthala: Human impact on water
Daluxolo: Oh, the human impacts on water. Draw another circle.
Buzwe: Human impact on water - we can pollute water

(TAT2G3, //1203-1207)

Daluxolo: Deforestation. Hey, they want human impacts on all the spheres?
Buzwe: Is it only water? I'm not sure, but I think so.
Daluxolo: Okay, let's ask. Then here also we can have … wastage of fresh water. We've got a crisis right now in South Africa
Fezeka: Mm
Daluxolo: We need fresh water. It's running out so we can say
Buzwe: Wastage
Daluxolo: Wastage of fresh water

(TAT2G3, //1246-1256)

- An example of a completed diagram is given in Figure 4.2 below. Completed diagrams for all groups can be found in Appendix K.

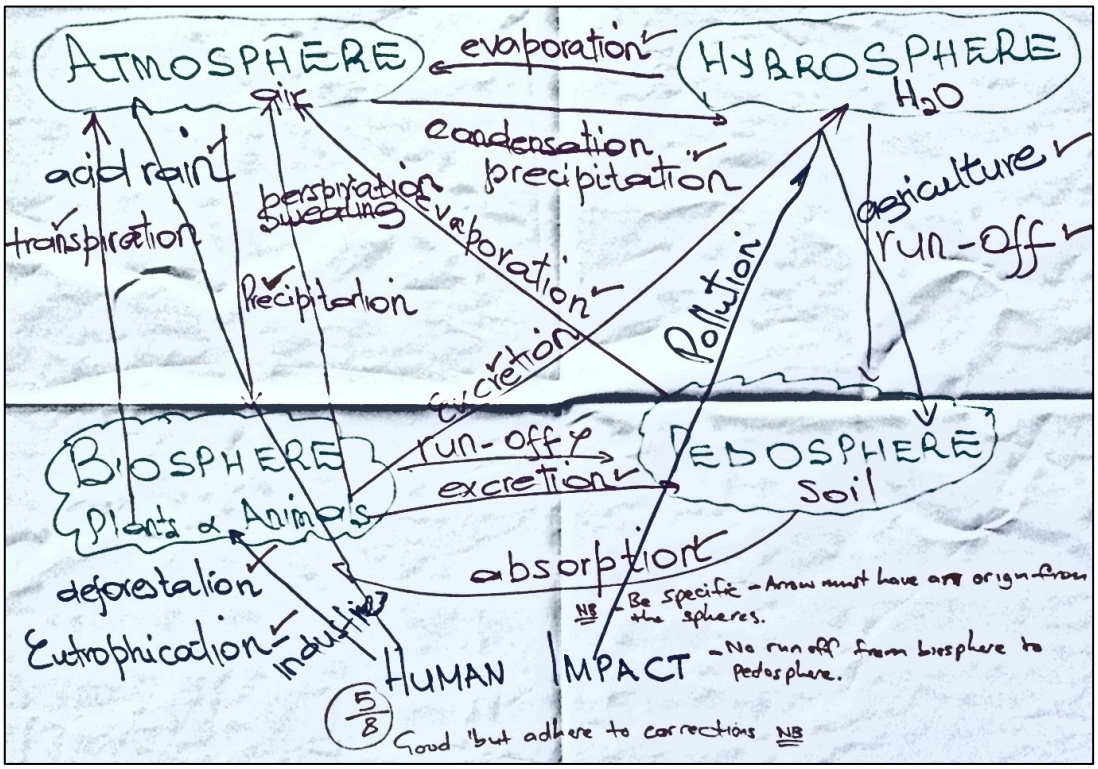

Figure 4.2 Group 2's completed diagram for the Water Cycle activity (G2WC(2))

- Diagrams were swopped between groups and assessed using a memo and rubric. Teachers initially gave comments referring to the overall presentation of the work but were then also asked to give constructive task-related feedback that could advance learner performance. This feedback is summarised in Table 4.2 below.

Table 4.2 Assessment feedback given by groups on another group's diagram of a water drop flowing through Earth's systems

	Initial comments	**Comments after request for 'constructive task-related feedback'**
Group 1 (feedback on G3WC(2))	-	All concepts are adequately identified and the inter-connections were well demonstrated
Group 2 (feedback on G4WC(2))	Very neat work	The cycle is incomplete Use scientific terms preferably
Group 3 (feedback on G2WC(2))	Good	Good but adhere to corrections Be specific – arrows must have an origin from the spheres No run-off from biosphere to pedosphere
Group 4 (feedback on G1WC(2))	Impressive	Work neatly and clearly Always make sure that [there are] no unidentified arrows

Teacher reflections on *Activity 6 'The water cycle'*

On the reflection and evaluation form, teachers were asked to reflect on their learning about the water cycle (Q6) and on the assessment aspect of this activity (Q7). The different representations of the content stimulated much discussion and clarification of the content. One teacher reflected on the content representation aspect of the activity with the comment:

> "The idea of following a drop confused some as we are used to looking at the water cycle in general and not a specific drop. However, it is a good way of looking at it but not for lower grades" (Teacher K, REF, Q6).

Other comments were predominantly on the content learning coming out of this activity:

> "interdependence of these sphere's was quite interesting" (Teacher C, REF, Q6).

> "Very interesting, challenges and stimulates thinking. Can be so useful and it was well presented by different groups meaning effective concepts were taught" (Teacher J, REF, Q6).

> "Understanding on how the spheres of earth interact with each other in all possible ways" (Teacher N, REF, Q6).

Four of the twelve comments made, reflected on personal learning about the use and purpose of a rubric and feedback for formative assessment:

> "How effective assessment can be [used] to track teaching and learning" (Teacher D, REF, Q7).

> "This was very useful because you get to evaluate what you are specifically looking for" (Teacher F, REF, Q7).

> "It teaches us how important is the rubric making" (Teacher I, REF, Q7).
>
> "Highlights the value of assessment and assessment techniques" (Teacher L, REF , Q7).

A further three reflections concerned the effect of working as a group to evaluate another group's work:

> "It was fun to have another group forced to provide feedback (constructive). It made us more accountable" (Teacher M, REF, Q7).
>
> "Creative thinking was encouraged here and we shared our ideas" (Teacher A, REF, Q7).
>
> "This was done by groups and shortcomings were exposed which opened up grey areas to be corrected" (Teacher C, REF, Q7).

The remaining comments expressed positive responses to the assessment part of the activity in general.

Activity 7 Big ideas and lesson planning

This 'Big ideas' part of this activity involved the completion of a CoRe template by teachers. Teachers were organised into groups according to the grade they taught. Lesson planning was mostly completed individually as a take-home task, but planning within groups of the content of each of the lesson plans took place during the session as each groups' lesson plans were to form a sequence of lessons to be taught. The lesson plans were submitted as an assessment to the course convenor. They were also circulated within each group so as to enable them to be used in the classroom. The activity steps were:

- Groups identified the 'Big ideas' or key concepts for the *Life & Living* CAPS topic they had chosen. The transcribed audio-recordings of the Grade 6 and Grade 7 groups' discussions, TAT3G2 and TAT3G1, respectively, showed evidence of the development of curricular knowledge. In the example below, the Grade 7 group is discussing the conceptual progression of the 'Big ideas' for the topic 'Variation'. This is followed by Table 4.3 showing the 'Big ideas' proposed by two of the groups. Transcripts of both completed CoRes can be found in Appendix L.

Mlondolozi: Ja reproduction is important ja
Akhona: Why?
Phumza: In order to have a different species there must be must be reproduction
Mlondolozi: Sustainability
Lwazi: Ja the continuing
Akhona: But doesn't this come up with inheritance? No
Mlondolozi: The continuation of the species depends on reproduction
Akhona: We've got to use reproduction because look that's what creates differences in inheritance hey
Lwazi: Because then the inherited characteristics form … different generations
(TAT3G1, //338 – 346)

Table 4.3 Key concepts for topics chosen by Gr 6 and Gr 7 groups

'Big ideas' for Grade 6 topic of 'Ecosystems and food webs'	'Big ideas' for Grade 7 topic of 'Variation'
1. Different ecosystems: There are many different natural ecosystems such as rivers, mountains etc 2. Living and non-living things in ecosystems. Relationship between living and non-living things 3. Food webs: In an ecosystem, plants and animals are connected by their feeding relationships. 4. There are different types of consumers in a food web eg herbivores, carnivores etc.	1. Living organisms of the same type belong to the same species 2. Organisms from the same species can reproduce sexually and produce offspring that are fertile and reproduce. 3. Variation is the difference between individual from the same species 4. This variation can be inherited from one generation to the next

- Groups discussed the questions on the CoRe template. Sample extracts of answers to some of the questions are given below. In the discussions on '*What teaching procedures or methods would you use, and why, for this idea?*' during this activity, there was some evidence of teachers sharing understanding of teaching strategies and their purposes, as shown in this extract from the Grade 7 group below:

Akhona: So my start would be 'question learners'. Question the learners understanding. That's the first thing, okay?
Mlondolozi: I have projects in the classroom - they are not learning it.
Lwazi: You can even add the five E's as one of the procedures. Like questioning would be about engaging that is ja, that is …
Akhona: Yes. Definitely
….
Phumza: And I think this is another … they talk about active learning. The discussions would be fine because you want as if you are challenging them because you ask from them 'what do you understand?'
Akhona: That's it. What teaching procedures … then we've also got to teach them active learning. We've also got to teach them concepts, haven't we –

‘what does variation mean?’
Lwazi: Mm yes exactly

(TAT3G1, //687-703)

There was minimal mention of content representations. However, a Grade 7 teacher in answer to the question ‘*How would you ascertain learner understanding?*’ proposed the use of pictures to overcome confusion about the ‘Variation’ topic.

Mlondolozi: There’s a lot of confusion (laughs). How would you ascertain learner understanding?
Phumza: If they don’t respond and then they just look at you when you are talking ….
Mlondolozi: I think that the best you can use in this case would be the use of pictures. I think pictures explain more when it comes to variation.

(TAT3G1, //709-713)

In the discussion extracts below on the question ‘*What do you know about learner thinking which influences teaching about this idea?*’ the Grade 7 group discussed the prior knowledge that should be in place for the topic of ‘Variation’:

Akhona: What do we know about learner thinking?
Mlondolozi: We’re talking about reproduction, reproducing of the same species.
Phumza: Learner thinking
Akhona: I think we need to say there is prior knowledge. What do we know about learner thinking? They have the prior knowledge with the angiosperm. Remember.
Mlondolozi: Yes. They did the whole of the plant thing.
Akhona: Yes
Mlondolozi: So there is prior …
Akhona: Angiosperm and from that human reproduction. Prior knowledge in the previous chapter of …
Lwazi: reproduction

(TAT3G1, //1041-1053)

The Grade 6 group identified areas of difficulty with the topic of food webs in an ecosystem as:

“Many students cannot use the seven life processes to differentiate living and non-living” (CoReGr6).

“Learners cannot differentiate a food chain from a food web” (CoReGr6).

“Learners struggle to explain that a food chain always starts with plants (producers)” (CoReGr6).

This group also discussed the contextual limitations of time and resources and how these factors would impact on their teaching of specific concepts (see Section 4.3.4.3 and Section 4.3.4.6).

- Teachers allocated lessons for individual members of the group to plan on the topic. The lesson plans produced by the members from these two groups (see Appendix N), reflected the progression of the 'Big ideas' presented on their group CoRe. The prior knowledge mentioned in the lesson plans showed that teachers had a clear idea of the conceptual progression in their topics as illustrated in the sample extract from a lesson plan below:

> **Lesson topic**: In an ecosystem plants and animals are connected by their feeding relationships
> **Prior knowledge**: Learners already know that an ecosystem is a place which has living and non-living things which depend on each other for survival
> (LPGr6T2)

Teachers in the Grade 7 group also discussed and shared with each other the various practical activities they had done with their classes that term. In the discussion extract below, teaching strategies and conceptual progression are evident:

> **Mlondolozi**: I did an investigation into the growth of a bean stalk within a
> **Phumza**: But they did that in grade 4
> **Mlondolozi**: Yes but now they are looking at 'with sunlight', 'without sunlight', 'without water'
> (TAT3G1, //1760-1762)
> ….
> **Lwazi:** We start of with 'what investigation am I doing?', then come up with a hypothesis, then state the apparatus then the method, then they put the table of results, then they produce a graph
> **Phumza:** So it's more than grade 4 is what you are saying. It's more like it's it's extended
> **Lwazi:** It's extended
> **Phumza:** Than grade 4 (unintelligible)
> **Akhona:** Its building up to the whole cycle, the process
> **Lwazi:** Its building too. Because it involves a lot it's got tables making tables, recording of results, making tables and we've got also observations
> (TAT3G1, //1884-1891)

Teacher reflections on *Activity 7 'Big ideas and lesson planning'*

Just over half of the reflections on the 'Big ideas' part of this activity concerned the advantages of doing the activity in a group. Some examples of comments are given below:

> "This was very useful. I could learn from others and gain new ideas. Also, everyone had their own ideas to bring to the table and we brought it together very well" (Teacher F, REF, Q8).
>
> "The group planning was good in that it led to ideas coming together then being perfected. It is different from individual planning where one just looks at one's ideas and develops that" (Teacher K, REF, Q8).
>
> "This promotes team teaching as teachers plan together the same topic. Learners in different classes can be taught using the same lesson plan" (Teacher O, REF, Q8).
>
> "It was wonderful because we had to share the different ideas which I did not understand and know" (Teacher P, REF, Q8).
>
> "As a group we analysed it and it assisted us in understanding that section of work in depth" (Teacher M, REF, Q8).

Roughly one third of the reflections were made around the usefulness of lesson planning as a skill as evidenced in the comments below:

> "[I learned] how planning could guide a constructive and effective lesson" (Teacher D, REF, Q8).
>
> "Personal development as a teacher that planning is a necessary skill. Always be sure of what you are doing as a teacher & what the learners are doing. Peer teaching is very necessary" (Teacher N, REF, Q8).
>
> "Always plan to achieve the lesson objectives" (Teacher N, REF, Q9).
>
> "It made me to be confident enough not to rely on our CA's to make lesson plans" (Teacher P, REF, Q9).

Half of the 16 reflections on the lesson planning part of the activity (REF, Q9) referred to specific aspects of the teacher's own learning that had been developed in some way such as:

> "Gave me a better understanding of the concepts that needs to be present in a ecology lesson" (Teacher B, REF, Q9).
>
> "It makes me to think carefully of what is my aim for this lesson, what do I want my learners to achieve" (Teacher I, REF, Q9).
>
> "Accommodate all levels of understanding when you plan the lesson. Involve a variety of teaching aids" (Teacher L, REF, Q9).

Activity 8 Assessment discussion

The purpose of this activity was to ascertain teachers' general understanding of assessment strategies, as well as the way in which assessment expectations have changed with the curriculum changes over the past few years. For this activity, teachers were given questions for group discussion, the answers to which were recorded on newsprint. These are transcribed below in Table 4.4.

Table 4.4 Group responses to the assessment questions in Activity 8

Questions	Group 1 (G1A)	Group 2 (G2A)	Group 3 (G3A)	Group 4 (G4A)
What is assessment?	Continuous and planned process of gatherings of the learners knowledge and understanding	Measuring, recording, analysing data/information, methods and skills	It is a measure of knowledge shared during teaching and learning period.	Processes of gathering information and discussing information
How has assessment changed since you were in school?	Formal assessment only and projects	Assessment has increased in quantity and quality	Before the implementation of OBE. Assessment were formative in a form of test and exams focus was content knowledge. After the implementation of OBE, NCS and CAPS Assessment become continuous. Focus skills, knowledge and values and understanding. Practical physical task become part of continuous assessment	Enormously
Why are there so many assessments these days?	Assessment is part of a continuous learning process. Teachers assess more, children learning less	To accommodate diversity of learning and to improve quality of learning	Assessment is holistic these days to address the needs of real life scenarios eg Sport, Art, poetry	To continuously get feedback from learners
What are the differences between assessment *of* learning and assessment *for* learning?	Assessment of learning – Testing knowledge and skills required during the lesson	of learning – summative, learner-based. for learning – teacher-based, to support the child – improvement of methods	Ass. of learning - assessing to check where they are / what they have learnt so far. Ass. for learning – giving them an assessment where they will learn while doing it eg investigation or project	-
To what extent have you been prepared for using assessment to maximise learning?	-	Use of a variety of assessment techniques	-	-

Activity 9 Assessment vignettes

This group activity was designed to stimulate discussion on the differing purposes and forms of summative and formative assessment. The activity was adapted from an assessment workshop developed by the Exploratorium in San Francisco (Assessing for learning facilitator's guide, 2006). The activity had the following steps:

- Teachers were given a series of four vignettes illustrating classroom formative and summative assessment practices to read and discuss. They then answered questions about the assessment strategies used.
- Teachers gave feedback on their group's discussion of the questions.
  An extract of one group's discussion is given below to illustrate the learning that appeared to be taking place:

> **Thembani**: In the first class you give them some work to do or on your part there was some information which the learners
> **Lwazi**: Which I gathered
> **Thembani**: Yes, but you gathered it through the assessment of that class. So when you go there to the other classes, you are now better equipped than the previous one, isn't it?
> ….
> **Lwazi**: I have assessed. You see in a way if you have learned something you have made an assessment
> **Thembani**: Yes
> **Thenjiwe**: Mm the assessment is not for learners only, its two way traffic
> **Lwazi**: It works two ways
> **Thembani**: Corrective assessment
> **Lwazi**: For my teaching. To improve my teaching, right? My teaching methods.
> **Thenjiwe**: To evaluate
> **Lwazi**: Yes, to evaluate. Yes and also for the children - for us to evaluate their level of understanding and where they are.
>
> (TAT4G2, //631-648)

Activity 10 Assessment of environmental learning in CAPS

The aim of the first part of the activity was to familiarise teachers with the revised Bloom's Taxonomy Tables (Anderson et al., 2001; Krathwohl, 2002) and to use these tables to allocate each of the assessment tasks listed in CAPS to a knowledge and cognitive process dimension. The knowledge dimension has four broad categories: factual; conceptual; procedural; and, meta-cognitive. These are set in a matrix, shown in Table 4.5 below, against

the cognitive process dimension with six categories: remember; understand; apply; analyse; evaluate; and, create.

Table 4.5 The Revised Bloom's Taxonomy Tables (Anderson et al., 2001)

	The Cognitive Process Dimension					
The Knowledge Dimension	1. Remember	2. Understand	3. Apply	4. Analyse	5. Evaluate	6. Create
A. Factual Knowledge						
B. Conceptual Knowledge						
C. Procedural Knowledge						
D. Metacognitive Knowledge						

The aim of the second part of the activity was to check alignment between formative and summative assessment activities in CAPS, paying attention also to process skills. Teachers worked in groups according to the grade they taught. The activity had the following steps:

- The revised Bloom's Taxonomy Tables were introduced and examples given of how the tables are used to allocate learning objectives to the knowledge and cognitive process dimensions.
- Groups discussed the location in the Tables of the assessment objectives given in the CAPS for the *Life & Living* strand for their grade. In the following extracts, teachers are working out where in the cognitive process and knowledge dimensions of the taxonomy to place the objectives listed under the *Assessment Guidelines* section in the CAPS. In the first extract below, the Grade 7 group is working with the objective 'Describe conditions that support life':

> **Akhona**: So am I going to do - am I 'understanding'?
> **Lwazi**: Don't you think that when they say describe conditions that support life you've already taught them about things that support life so it's just 'remembering' 'recalling'
> **Akhona**: Perfect so that's where it's going to fit in
> **Viwe**: 'Remember'
> **Akhona**: That first one there it's going to fit into 'remember' and it's 'factual'
> (TAT5G1, //265-270)

In this extract, the same group is working on the objective 'sort plants and animals into groups based on observable similarities':

> **Phumza**: I know - 'understanding'
> **Akhona**: Mm so it could be 'categorise'

Lwazi: 'Sort' could also be 'application'
Akhona: Ja I also think so
Lwazi: Because you can sort and apply the knowledge that you got
Akhona: We looking there sort animals so you actually
Lwazi: Sort plants and animals into groups
Akhona: And you physically doing it
Lwazi: So you applying the knowledge
….
Viwe: Would you go so far as saying 'evaluating'
Lwazi: Mm no I don't think evaluating will work
Akhona: On observable similarities no
Lwazi: I would put it under 'application'. 'Sort' can also be there

(TAT5G1, //360-380)

In this extract, the Grade 6 group of teachers are trying to allocate the objective that learners can 'Explain how plants make their own food (photosynthesis)' to a knowledge dimension in the Taxonomy:

Sonwabo: It's a theory. It's knowledge
Daluxolo: But the fact is they explaining how food is made so they going to have to start explaining from the sun giving energy
Fezeka: Yes so the interrelationships between
Mabhuti: It's 'procedural'
Daluxolo: Ja, so it has to fall under here. It can't fall under 'factual'
Fezeka: Mm mm
Daluxolo: It can't fall under 'factual'
Mabhuti: But isn't it a scientific method that you use to explain the concept?
Fezeka: It's not in scientific methods

(TAT5G2, //189-198)

- Teachers were then asked to check the alignment between the formative activities and summative assessment objectives as recommended by the CAPS by comparing the cognitive and knowledge dimensions and the process skills involved.
- Groups gave feedback on the activity in the form of reflections on their learning and their use of questions of different cognitive demand:

Viwe: Most of the times I find that … most of these skills – I apply them. Because I today was busy trying to find out if kids can recall from Term 1. Since there's examination next week that covers Term 1 and Term 2.
Nomvuyo: You mean the cognitive?
Viwe: (nods) Recalling of information. But you find that they can classify. And find out if they can compare.
…
So we normally use this [different cognitive levels] but sometimes its unknowingly. But, the problem is when it comes to setting the examinations.

> Mid to higher order level questions - so we find out that we look at … we want the kids to pass. So we try to just have lower order to middle order, not catering for the higher order. (TAT5G1, //1531-1544)

> **Nomsa**: I think what I've learned is to actually really think about how I set up an assessment. But like Sonwabo said, we are using this maybe in a - what was the word that you used?
> **Sonwabo**: Unconscious
> **Nomsa**: Some, yes, way. We are using this but - this is good, coming and refreshing your memory or your skills. Its all so good. So when you go back to the class you can actually think about your questioning and thinking about how you're going to set up your assessment now, type of thing. So, this was a good process. (TAT5G1, //1575-1581)

> **Akhona**: I thought it was was very, very interesting. Bringing together the formative and the summative, that for me spoke volumes because it made me realise that so much of what I'm testing that I thought was so hard, is actually middle order! So I'm going back tomorrow to look at my exam paper. (TAT5G1, //1514-1517)

Various other issues around assessment were also mentioned. Lack of time was raised by two teachers, but referring to different aspects of classroom practice: Viwe commented that time does not allow for one to check the cognitive levels of activities "because the curriculum is so packed. Because of the volume of work that you have to … that I need to get through" (Viwe, TM5, //461 – 462) whereas Zuko felt that "the most challenge that we have in science is time allocated to science" (Zuko, TM5, //585 - 586) as there was not enough time to give adequate attention to all the terminology that needed explanation. Thembani was quick to point out that it is important that teachers do not avoid terms and terminology as, if something is skipped, it may only be dealt with again years later (TM5, //597 - 601). Part of the reason why terminology took so long to teach was related by the teachers to language, described by one teacher as "the biggest problem" (Khuthala, TM5, //595). Two teachers shared their strategies for trying to facilitate around language issues: suggesting that learners "identify … main facts and just then write it in point form" (Daluxolo, TM5, //555 – 556); and, the use of a framework given to learners that "for the action verbs, they explain fully what is meant by describe, what is meant by explain" (Fezeka, TM5, // 567-568). Another issue raised was that of resources with Sonwabo commenting that "we don't have the apparatus for the kids to investigate and like observe or whatever. So I try to use real life, so that it makes sense for them" (TM5, //500-501). And finally, Akhona's epiphany as she realised that the content focus in CAPS with all its assessments, was impacting on her teaching in that she felt she was losing sight of the learners (see Section 4.3.4.2).

4.2.2 Characteristics of the professional development programme

When teachers are attending a professional development course, the characteristics of the professional development also have the potential to affect the development of PCK (see Section 2.6.2). A feature of the *Fundisa for Change* courses is the participatory method of delivery. In the *Guidelines for Facilitation of the Fundisa for Change Teacher Education Programmes* document, the programme is described as "a carefully designed, facilitator led, inter-active professional development programme that has a strong structure, but with opportunities for teacher participation, practical and reflective engagement with concepts, approaches and ideas, informed by TPD [Teacher Professional Development] research and best practices" (Fundisa for Change Programme, 2014, p. 1). Two characteristics that emerged as themes from the data were the content focus and the opportunities for active and collaborative learning through group-work. The effect of these two characteristics on the development of teachers' knowledge is presented below.

4.2.2.1 Content focus

In Section 2.6.2, a focus on content in a professional development programme was described as necessary for the development of PCK. In the *Fundisa for Change Teaching Life & Living* course, opportunities to engage with environmental content knowledge were provided in three of the five sessions. All of the course activities that focused on content knowledge were presented in such a way as to also model or elicit pedagogical and/or assessment strategies for the teaching of the content. In this way the course was supportive of the idea that "content understanding needs to take place alongside an understanding of how the content is to be taught" (Rollnick, 2016, p. 33). Data regarding the content knowledge that emerged is discussed as part of the content knowledge component of PCK in Section 5.3.3.

4.2.2.2 Opportunities for active and collaborative learning through group-work

Each of the five sessions comprising the course, were between 2 ½ and 3 hours long. The first session allocated 1 ½ hrs to activity discussions, with around 30 minutes for introductions to and explanations of activities and another 30 minutes for feedback (S1OBS). Sessions 2, 4 and 5 all had roughly one hour of introduction and explanation time and one hour of discussion time with between 15 and 30 minutes of feedback time. In Session 3,

teachers completed an assignment and spent just over two hours in discussion with peers following a 17-minute introduction (S2OBS – S5OBS). Altogether during the course, teachers spent 55% of the time in focussed discussion.

Within the context of the professional development course, the opportunities for collaborative group-work appeared to promote teacher learning. In particular, in reflections on *Activity 7* which involved group planning of the conceptual progression for the teaching of an environmental topic, ten of the 15 teachers referred to the advantages of doing the activity in a group (see Teacher reflections on Activity 7, Section 4.2.1). In addition, half the teachers made reference to specific aspects of their own learning about the lesson planning process that had been developed in some way while a further quarter of teachers related their learning back to the group work that had preceded the lesson planning with comments such as:

> "Interesting especially after group discussions. Group work made things easy" (Teacher J, REF, Q9).
>
> "Though it was individual planning the whole idea of the lesson had been discussed by the group" (Teacher K, REF, Q9).

In answering the question in the reflection and evaluation form regarding the best aspect of the course facilitation, four of the 15 teachers commented that the best aspect was the group-work and planning for teaching. This was supported with comments such as: "To group us and then we will take turns to present what we have done as a group" (Teacher I, REF, Q2.12) and "Group planning in preparation for lesson planning" (Teacher A, REF, Q2.12), with a further two commenting on the "interactive way of engagement on topics" (Teacher D, REF, Q2.12). The collaborative learning thus acts as a means for the teachers to learn from the prior knowledge and ideas of others. Opportunities for collaboration appear to be an amplifier to learning for teachers on the course.

4.3 The teachers within the *Fundisa for Change Teaching Life & Living* course

The above section described the enactment of the professional development course in detail. The focus now shifts onto the second of the elements of the professional development system – the teachers. Teachers arrive to do the professional development with a set of beliefs about

knowledge and learning, a level of prior knowledge and an understanding of the contexts in which they teach. Teacher beliefs, orientations, prior knowledge and context are all presented in the Summit Consensus Model (see Section 2.2.2) as having a filtering or amplifying effect on teacher learning and classroom practice, as well as on teachers' personal PCK. The evidence of filters and amplifiers (see Section 2.3) mediating teachers' learning during the *Fundisa for Change Teaching Life & Living* course and the impact they have on teacher learning and teachers' personal environmental PCK is presented in this section.

The amplifiers and filters identified are presented according to themes that arose from the data and were recorded in the analytic memos in the Phase 1 analysis. The themes were compiled by drawing on the following data sources:

- the teacher contextual profile questionnaires (CPQ1 – CPQ17)
- the session transcripts capturing the facilitator transactions (TM1 – TM5)
- the transcripts of the group discussions (TAT1G1 – TAT5G4)
- the groups' outputs during the course activities (see Table 3.7)
- the teacher reflections on the activity from the course reflection and evaluation forms (Teacher A, REF – Teacher P, REF).

Teacher biographical information is presented first in Section 4.3.1, followed by data regarding teacher beliefs and orientations as amplifying or filtering PCK in Section 4.3.2. The amplifying and filtering affects of teacher prior knowledge and context are presented in Section 4.3.3 and Section 4.3.4 respectively.

4.3.1 Teacher biographical information

The seventeen teachers attending this course were all in the process of completing a two-year part-time Advanced Certificate in Teaching: Senior Phase Natural Science (ACT) at the University of Cape Town (UCT) (see Section 3.2.2). The group of teachers was diverse from a number of perspectives as illustrated in Table 4.6 below representing information from the teacher contextual profile questionnaires (CPQ1 – CPQ17).

The teachers also vary in terms of work experience, with three of the teachers being relatively recently trained with up to five years teaching experience and four of the teachers having

over 20 years of teaching experience. The remaining ten teachers had between ten and twenty years of experience (CPQ1, 1Q1 – CPQ17, 1Q1).

Table 4.6 Summary of biographic and demographic details for the participants in the study

Characteristic	**Sub-categories**	**Number of participants (n = 17)**
Age group	20 – 29	4
	30 – 39	3
	40 – 49	9
	> 50	1
Grade currently teaching and years of experience (Least experienced have < 5 yrs Most experienced have > 20 yrs)	Intermediate Phase (Grade 4-6) Senior Phase (Grade 7-9)	9 of which 2 have < 5 yrs and 1 has > 20 yrs 8 of which 1 has < 5 yrs and 3 have > 20 yrs
Received formal training in Natural Science …	Content	9
	Pedagogy	9
	Classroom practice	11

4.3.2 Teacher beliefs and orientations as amplifying or filtering PCK

As noted in Section 2.3.1, teachers' beliefs can act as a lens through which teachers make sense of their classroom experiences and learning from professional development. Research has also found that teachers' beliefs are not static, but change over the career of the teacher (Luft & Roehrig, 2007). Data generated regarding teachers' beliefs came from two sources: the Teacher Beliefs Interview questions (Luft & Roehrig, 2007) designed to elicit teacher beliefs about knowledge and about learning, included in the teacher contextual profile questionnaire; and, the discussions amongst the teachers during the course. This data is used to understand teacher amplifiers and filters that may impact on the development of environmental PCK.

Table 4.7 below shows the teachers' responses from the contextual profile questionnaire (see Appendix G) to the Luft and Roehrig (2007) Teacher Beliefs Interview questions (see Table 3.2). The first three questions in the table related to beliefs about knowledge and are grouped separately from the four questions relating to beliefs about learning. Teachers' responses to each question were allocated using the Luft and Roehrig belief question maps (Luft & Roehrig, 2007, pp. 57-63) to one of five categories with the placement of a response represented by a '*' in Table 4.7. The traditional (Trad) and instructive (Instr) categories represent teacher-centred beliefs while the responsive (Resp) and reform-based (Reform)

categories represent learner-centred beliefs (see Table 3.9). The transitional category focuses on behavioural aspects of learners as against cognitive aspects. The frequency of responses within a particular category thus gives a visual representation of the beliefs of this group of teachers along a continuum from teacher- to learner-centred beliefs.

Table 4.7 Summary of the frequencies of the seventeen teacher's coded responses to the seven Luft and Roehrig (2007) Teacher Belief Interview questions

	Teacher-centred		**Transitional**	**Learner-centred**		**Total no. of responses**
Questions on beliefs about knowledge	**Trad**	**Instr**		**Resp**	**Reform**	
CPQ, 2AQ2	****	*****	******	*	-	16
CPQ, 2BQ8	**	**********	*	**	-	17
CPQ, 2BQ9	**********	*	**	***	-	17
TOTAL	**17 (35%)**	**18 (35%)**	**9 (20%)**	**6 (10%)**	**0 (0%)**	**50 (100%)**
Questions on beliefs about learning	**Trad**	**Instr**	**Transitional**	**Resp**	**Reform**	
CPQ, 2AQ4	**		*********		-	11
CPQ, 2AQ7		**********	****		-	17
CPQ, 2BQ9		*	*******	********	-	16
CPQ, 2BQ10	***	*****	********	*	-	17
TOTAL	**5 (8%)**	**19 (31%)**	**28 (46%)**	**9 (15%)**	**0 (0%)**	**61 (100%)**

The table yielded the following observations:

- 70% (35 out of 50) of total responses to the questions on beliefs about knowledge fell into the teacher-centred category, with an even spread over the two sub-categories of traditional and instructive. The data thus indicates that roughly 35% of the teachers had traditional, teacher-centred beliefs, focussed on information, structure and the transmission of knowledge while another 35% had instructive, teacher-centred beliefs and wanted to provide experiences for learners while retaining a teacher focus. The remaining 30% was spread over the transitional and learner-centred responsive categories.
- 46% (28 out of 61) of responses to the questions on beliefs about learning fell into the transitional category with teachers believing in teacher/learner relationships, subjective decisions or affective responses. Together with the instructive sub-category, these two categories accounted for 77% of responses.

Note that not all the teachers responded to all of the questions resulting in the variation in the total number of responses recorded on the right of the table.

The questions with most responses tending towards more learner-centred beliefs were three of the questions on beliefs about learning. With research into the relationship between learner-centred beliefs about learning and the development of PCK showing a largely positive correlation (see Section 2.3.1) one might reasonably expect that teachers showing learner-centred beliefs about learning would be prepared to entertain teaching methods that supported a learner-centred approach. For this reason, teachers' responses to these questions were of interest and their responses to each of these questions are presented below. The teachers' emergent PCK around the component of pedagogical knowledge is discussed further in Section 5.3.2.

Responses to Question 2. How do you maximise learning in your classroom?

Three of the teachers chose not to answer this question and another two wrote comments that did not answer the question. Of the remaining 12 responses, half mentioned active or participatory learning activities, or the engagement of learners in practical work. These responses all fell into the transitional category. The others cited diverse strategies such as group work, consolidation, questioning, explaining or allowing learners to express their understanding. Some examples of the transitional responses are:

> "Bring participative activities where each child will have to participate/play a role" (Daluxolo, CPQ3, 2AQ4).

> "By giving learners more time to do practical work than listening to me." (Fezeka, CPQ5, 2AQ4).

Responses to Question 6. What types of learning activities do you see the learners benefiting from the most?

Teachers' responses to this question fell predominantly into the transitional and responsive categories indicating that they recognise practical activities and group work as beneficial to the learners. Some illustrative responses are:

> "practical activities, activities that involve learners, activities that pertain to/include their experiences, hands on, activities that involve the environment (ie outdoor)" (Buzwe, CPQ11, 2BQ9).

> "Active learning, group work, learner-centred" (Nomsa, CPQ2, 2BQ9).

Responses to Question 7. How do you know when learning is occurring in the classroom?

Just under half of the teachers' responses fell in the transitional category emphasising subjective conclusions about the learners such as active involvement in the lesson. Typical responses are:

> "I know when I see the participation and the answers being given during the course of the lesson" (Lwazi, CPQ14, 2BQ10).
>
> "When the learners are able to relate the topic to their daily life experiences" (Mabhuti, CPQ4, 2BQ10).

A further five responses fell in the instructive category, emphasising the correctness of responses from learners according to measurable outcomes such as tests. Of the remaining four teachers, three gave responses that fell in the traditional category, whilst just one gave a learner-centred response.

4.3.3 Teacher prior knowledge as amplifying or filtering PCK

As stated by Gess-Newsome (2015), the structure and depth of a teacher's prior content knowledge may act as an amplifier or filter to professional development experiences (see Section 2.3). In the group of teachers participating in this study, only nine (out of 17) said that they had received input during their formal teacher education or training in the Natural Sciences at the level that they teach (CPQ, 1Q2a). The same nine teachers also received input regarding pedagogy for Natural Science teaching as part of their formal training (CPQ, 1Q2b). The incoming content knowledge of this group of teachers was not formally assessed in any way. However, differing levels of content knowledge were evident in their group discussions and are reported on in Section 5.3.3. During the course, the development of content knowledge was specifically targeted through three of the activities: *Activity 1 'Movie'*; *Activity 2 'Build a better world'*; and, *Activity 6 'The water cycle'*. One of the core characteristics of effective teacher professional development is a focus on content, providing the foundation upon which PCK can develop (see Section 2.6.2).

4.3.4 Teacher context as amplifying or filtering PCK

Teacher context is also presented in the Summit Consensus model (see 2.2.2) as having a filtering or amplifying effect on the development of teachers' personal PCK (see Section 2.3.3). As described in Section 2.6.1, Grangeat and Hudson (2015) expand the contextual

influences on teachers to include social, classroom and instrumental contexts. Aspects of all three of these contextual influences emerged as themes from the data and are described below.

4.3.4.1 Professional Learning Community (PLCs) at school – the social context

According to Grangeat and Hudson (2015), the "social context in which teachers are embedded influences their PCK growth" (p. 208). The social context includes aspects such as the professional community of teachers within the school, the orientations, culture and habits of the teacher group and the leadership and organisation of the collective work (Grangeat & Hudson, 2015). All of the teachers participating in this study, were teaching at public schools, with one of those being a special needs school. In the teacher contextual profile questionnaire, there were seven questions regarding the professional community of teachers at their schools. The answers to these questions are summarised in Table 4.8 below. Professional practices such as professional collaboration and being part of a learning community at school are thought to be opportunities for teachers to informally develop their PCK and further their professional learning (OECD, 2014a, p. 166).

Table 4.8 Responses to 2AQ3. On average, how often do you do the following in this school?

	Never	**Once a year or less**	**2 – 4 times a year**	**5 – 10 times a year**	**1-3 times a month**	**Once a week or more**
Exchange and co-ordination of teaching						
b) Observe other teachers' classes and provide feedback	2	7	6	1	0	1
c) Exchange teaching materials with colleagues	0	2	0	3	5	7
e) Engage in discussions about the learning development of specific learners	0	1	2	2	2	10
f) Work with other teachers in my school to ensure common standards in assessments of learner progress	1	0	2	0	2	12
TOTAL /68	**3**	**10**	**10**	**6**	**9**	**30**
Professional collaboration						
a) Teach jointly as a team in the same class.	11	3	1	0	1	1
g) Attend team conferences/meetings	0	0	5	3	6	3
h) Take part in collaborative professional learning	0	3	3	3	4	3
TOTAL /50	**11**	**6**	**9**	**6**	**11**	**7**

The answers to these questions showed that the more frequent professional community behaviours engaged in by this group of teachers were exchanging of teaching materials with colleagues, engaging in discussions about learning development of individual learners and collaboration around common assessments. Less frequent behaviours were observing other teachers' teaching and co-teaching. Attendance of team meetings appeared to vary, as did taking part in collaborative professional learning. From this we can see that the social context at school appears to influence access to certain professional learning opportunities or activities.

4.3.4.2 Context of curriculum as filtering or amplifying knowledge

As noted above, any aspect of the contexts within which the *Fundisa for Change Life & Living* course took place has the potential to have an amplifying or filtering effect on how a teacher selects knowledge and actions for the classroom. In this section, the effect of teachers' perceptions of the curriculum is presented. Two intertwined issues emerged here: time and the focus on assessment. The following extracts and comments show how the clearly defined time frames given in the CAPS for teaching topics take on a filtering role influencing a teacher's actions.

From the teacher Contextual Profile Questionnaire, when asked 'How do you decide when to move on to a new topic in your classroom?' the majority (12 out of 17) of the teachers indicated that they would move onto a new topic after receiving feedback via an assessment that there was understanding of the concepts taught. The level of understanding required from learners was mostly not stated. For the three teachers who did indicate a criterion, this varied from around a 50% mark in assessment to all learners as indicated by their comments below.

> "When the learners can do a small quiz on the topic discussed and gain at least 45-50%" (Lindiwe, CPQ1, 2AQ8).
>
> "If all the learners are able to demonstrate the outcomes of the lesson" (Mabhuti, CPQ4, 2AQ8).

Six teachers mentioned the CAPS in their responses. Two of the teachers reflected that they would move on to a new topic based solely on the time frames in CAPS and "irrespective of whether learners understood or not" (Thenjiwe, CPQ10, 2AQ8). The other teacher wrote:

"Limited choices because CAPS tells you where you should be when. Therefore sometimes I left while learners don't understand – why? Because of Time" (Zuko, CPQ16, 2AQ8).

Four teachers indicated feeling constrained by the CAPS but also showed varying levels of flexibility in dealing with the perceived constraints as seen in the responses below:

> "The CAPS curriculum is designed in a way that it is difficult to reteach a lesson because most of the time you have to teach to assess not for the learner to understand" (Sonwabo, CPQ12, 2AQ8).
>
> "CAPS document provides guideline of time frames but I will re-teach an aspect that requires more attention" (Akhona, CPQ17, 2AQ8).

Another of the teacher Contextual Profile Questionnaire questions was 'How do you decide what to teach and what not to teach within a particular topic?' The majority of the teachers (12 of the 17) responded that they use the CAPS as a guideline with two also mentioning input from the curriculum advisors. Of the remaining five teachers, one mentions that he "personally add[s] information to support needed information" (Zuko, CPQ16, 2BQ8) whilst the other four mention, in differing degrees, the influence of the learners on their decision-making process, as indicated below:

> "Determined by the readiness of learners, based on their prior knowledge, age, completion of the previous lesson" (Mlondolozi, CPQ6, 2BQ8).
>
> "Depending on the assessment requirements and also how long learners will take" (Nomsa, CPQ2, 2BQ8).

The next example shows how time allocated to topics in CAPS impacts on a teacher's use of formative assessment strategies such as giving feedback to learners on written assignments or tests. In this extract from a group feedback conversation about formative assessment in the fourth session, the teachers explain:

> **Thenjiwe**: The problem is time allocated to CAPS. It's only for the content. It's working through the content. There's no time allocated for feedback. When you give them a test, you mark it at your own time because you are rushing to teach them something new again. We don't have time to really look at the assessment and discuss it. We would like to do that, but we don't have time. Really.
> ….
> **Sonwabo**: I agree with Thenjiwe about time because most of the time we find out that because of this recent curriculum you are teaching to assess, not teaching for understanding. You are teaching to assess to cover what the CAPS document

want you to cover, not what you want the kids to understand. So whether the kids understand you
Thenjiwe: or not
Sonwabo: is not applicable because they want you to cover those concepts. So most of the time you find yourself that you are teaching to assess not the other way around. So that's why kids are struggling to relate this, whatever you are teaching in class, with real life. (TM4, //527-545)

Another teacher commented on the reflection and evaluation form that "Learners learn better when they find information themselves than to be told. Experimentation is time consuming but a good teacher" (Teacher L, REF, Q10). From the extract of discussion below from a group doing planning around the concept of diversity within a species for the Grade 7 topic of Variation, it appears that here time was seen as constraining opportunity for discussion:

Mlondolozi: Any other factors?
Akhona: Time constraints
Mlondolozi: Mm, Mm
Akhona: Because of those, it lends itself to so much discussion. Do you do discussions? Then you've got to discuss the myths and you got to talk about all the cultures and you know all the discussions that take place
(TAT3G1, //658-663)

Time also came up as an issue in the implementation of practical work during group discussions on topic planning in *Activity 7*, with both recorded groups commenting that there was not enough time allocated for practical work:

Sonwabo: The questions is 'what are the limitation of teaching the topic living and non-living things in an eco-system?'. I think the limitation is for you to go out and use the hands on approach. It's difficult because of time.
(TAT3G2, //107-109)

Mlondolozi: You don't do two practicals for one topic. It's very difficult because you have to rush them
Lwazi: Ja
Mlondolozi: So you don't have much time to to do all these things
Phumza: Mm
Akhona: You're right
Mlondolozi: You can just do one activity
(TAT3G1, //1446-1452)

And finally, an epiphany for one teacher as she realised how the content focus in CAPS with all its assessments, was impacting on her teaching:

> **Akhona**: I've realised though that with us teaching and with the volume as Viwe was saying, what concerns me is that I'm now, having done this today, I see how I'm teaching to be able to test. And that should never have been… that's been an eye opener for me. Is that my… I've lost … I think I've lost the point of the children. I'm thinking differently about it now. Because of chasing content. So, that's a worry. (TM5, //493-499)

The above discussions reflect some of the frustration the teachers experienced with the CAPS focus on assessment in its implementation. The knock-on effect of this time pressure appeared to be that teachers adjusted their pedagogical and assessment approaches. Teachers perceived the fullness of the curriculum in terms of content topics and time allocated, as restricting of their ability to implement a variety of teaching strategies such as practical work and discussion and formative assessment strategies such as providing feedback to learners. Thus the time frames given in the CAPS for teaching topics took on a filtering role influencing a teacher's instructional and assessment actions.

4.3.4.3 Teachers' classroom context

According to Grangeat and Hudson (2015) understanding the classroom context of teachers is important as "the way classroom practices unfold and students perform directly interacts with teacher professional knowledge" (p. 210) (see Section 2.6.1). Two inter-related aspects of classroom context that emerged as themes were class size and discipline.

Four of the teachers mentioned discipline and behavior-related issues as specific challenges (CPQ2, 2BQ12; CPQ3, 2BQ12; CPQ6, 2BQ12; CPQ7, 2BQ12), with two of these teachers linking discipline problems to overcrowding in the classroom. Nine of the teachers had class sizes of between 27 and 40 learners. Seven had classes of 40 or more learners with the largest class size being 51. One teacher, teaching in a special needs school, had a class size of 14. During group feedback in the first session, to illustrate the concept of resilience, one of the teachers gave as an example: "If you are in [a large] size class, you don't have resources in your class, you have to improvise" (Phumza, TAT1G2, //176-177). In the following session while giving feedback on *Activity 5* regarding different teaching strategies, the same teacher commented: "I think these method would be … good but for our … number of learners in our classes it's going to be too hard" (Phumza, TM2, //673 – 674). In another instance, two teachers in discussion about showing a short movie in the classroom, commented:

> **Viwe**: Ja, ja. But being realistic, yes some of us do it in smart schools and do

have the capabilities already to show movies like this. But the sad reality perhaps, is that most of us are faced with classes that reaches fifty learners so how … are you going to keep it constructive in a scenario like this?
Akhona: I would in terms of this lesson I would definitely show the video again.

(TAT1G1, //122-125)

Responses to the two questions related to classroom discipline are given in Figure 4.3 and Table 4.9 below.

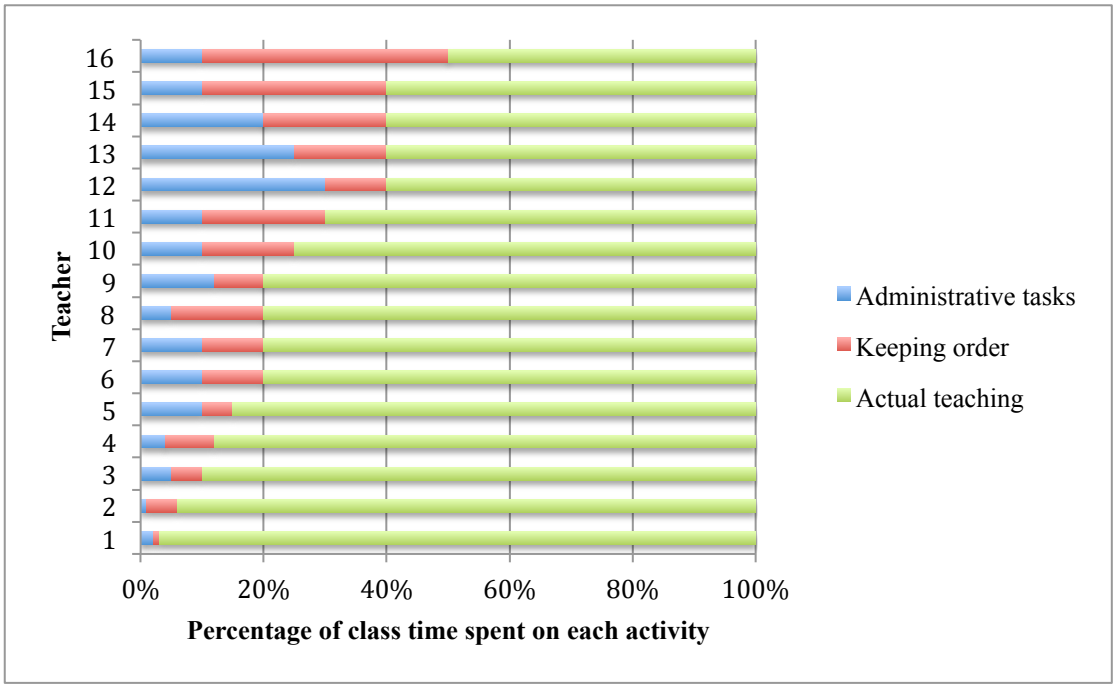

Figure 4.3 Responses to 2BQ7. What percentage of class time is typically spent on each of the following activities?

From this figure, one can see that the range of time spent keeping order varied from 1% to 40% of a lesson. The median time taken away from actual teaching by administrative tasks and keeping order together, amounted to 20%.

Table 4.9 Responses to 2BQ11. How strongly do you agree or disagree with the following statements about the learners in your target class?

	Strongly disagree	Disagree	Agree	Strongly agree
a) When the lesson begins, I have to wait quite a long time for learners to quieten down	4	7	6	0
b) Learners in this class take care to create a pleasant learning atmosphere	0	3	12	2
c) I lose quite a lot of time because of learners interrupting the lesson	3	7	6	1
d) There is much noise in this classroom	3	10	4	0

In this question, a), c) and d) are reverse-coded ie. the more favourable response would be to disagree. Fourteen of the teachers find that learners do make an effort to create a pleasant learning atmosphere. One of the teachers, who disagreed with this statement, is the same teacher who spends the most time keeping order in the class and also strongly agreed that he loses a lot of time because of learners interrupting the lesson.

4.3.4.4 Learner characteristics

The questions answered in the section of the Teacher Contextual Profile Questionnaire that asked teachers to select in their minds a particular science class that they teach and to then answer questions about this target class, gave a sense of the learners of this particular group of teachers. The responses to the questions are shown in Table 4.10 below.

Table 4.10 Frequency of responses within percentage intervals regarding learner characteristics (n = 17)

Section 2B Question 5. For your target class, please estimate the broad percentage of learners who have the following characteristics.	**Frequency of responses with percentage of …**			
	0 – 25%	26 – 50%	51 – 75%	76 – 100%
a) Learners whose first language is different from the language of instruction	7	1	0	9
b) Learners who have parent/guardian/sibling who can give academic support at home	8	6	2	1
c) Learners who have access to a library	3	6	0	8
d) Learners who have access to the internet via cellphone or computer	8	3	2	4
e) Learners who have access to a computer	11	2	1	3
f) Learners who have access to a television	1	1	1	14
g) Learners who are above average age for this grade	12	5	0	0
h) Learners who are motivated to achieve	3	6	4	4

Language of learners

Results in Table 4.10 show that amongst this group of teachers, just over half reported that their classes had more than 75% of learners with their first language different from the language of instruction. In question 2BQ12 teachers were asked about specific challenges they have with their target group of learners. Three teachers mentioned lack of reading and/or writing skills as specific challenges (CPQ1, CPQ4, CPQ15), with one teacher mentioning language of instruction specifically (CPQ16, 2BQ12). This teacher also mentioned in particular the scientific terms used in the environmental topics as challenging as a lot of time was used to explain the terminology (CPQ16, 2BQ15 & 16). Another teacher commented that

learners resist reading and writing activities (CPQ15, 2BQ15 & 16). Of these four teachers, three have close to 100% of learners in their class having their first language different from the language of instruction. Some of the ways in which the teachers adapted their practices to accommodate these challenges are illustrated by the comments below. The first comment describes a formative assessment strategy a teacher uses to know if learners have understood text:

> **Lindiwe**: So we go through it like: Question 1 what is your answer? One person. And then did anyone have another answer? Okay, that one. And then we say okay that was **the** answer. Why is that the answer do you think? Just ten minutes. Not more than ten minutes and then I'm done. And then that for me I found that that also kind of consolidates that they understood what was happening in the notes and also how to apply the notes to the questions in the activity because sometimes, like somebody now just said, they don't know how to get the information to the question and they write their own stuff. They sometimes even some of them don't know they are supposed to go back to the notes and actually look, although I tell them use the notes we just wrote to answer the activity. But I found that using that ten minutes kind of strengthens their understanding, the strong ones, we always have those ones that lag behind. But like the strong ones they do get it after a while, after the third activity thing then they do get what you are trying and they become more responsive.
> (TAT4G2, //1110-1121)

This comment was made during a discussion on assessment during *Activity 10* on learner's response to the word 'Explain' or 'Describe' being used in a question:

> **Daluxolo**: … Like with most of them you find that there is a language barrier that they start explaining and they start writing something else totally. So what I try to even do is 'identify your main facts and just then write it in point form.' So, I don't know, is that good? Is it bad? Because when they start explaining, I tell you its …
> **Nomvuyo**: You have to give them a framework … Its good then if they write in full sentences. You teach them …
> **Daluxolo**: Ja, during classwork I do that, but then when it comes to examinations now I try to limit them from writing because they really go way … out of the, they fail to get the whole idea (TAT5G1, //1615-1625)

Learner participation

In the Natural Sciences, practical work provides an opportunity for learner participation to be developed. In question 2BQ13 on the contextual profile questionnaire, half of the teachers commented that practical work was the aspect of Natural Science that learners tended to perform well in. The reasons ascribed to this, given as answers to question 2BQ14, focused on practical work involving active participation of the learners such as "they are using their

hands and they see what they are doing" (Fezeka, CPQ5, 2BQ14) and "they are directly involved" (Buzwe, CPQ11, 2BQ13). A further five teachers identified the *Life & Living* strand as an area learners perform well in, saying that learners can relate this section to their everyday experiences more easily than some of the other strands. The remaining teachers highlighted other strands but gave as their reasons the practical aspects.

Learner motivation

There was a lot of variation in teachers' responses about the percentage of learners in their classes who are motivated to achieve. In question 2BQ12 of the teacher profile questionnaire, four teachers mentioned motivation of learners as a specific challenge to their teaching. One of the teachers wrote that learners with social issues "lack motivation and vision for the future" (Buzwe, CPQ11, 2BQ12). This same teacher also saw motivating learners as part of his role as a teacher and a way of maximising learning in his class. He stated that he knows when learning is occurring in his class "when learners are motivated to face a new challenge" (Buzwe, CPQ11, 2BQ10). Motivation was also linked to opportunities to do practical work in class with teachers commenting that "they get so interested and show eager[ness] to work when given practical work" (Phumza, CPQ15, 2BQ14) and "they enjoy it a lot because they are in most cases working in groups" (Thembani, CPQ13, 2BQ14). Practical work also has the potential to be an opportunity for learner self-regulation and this was mentioned by two of the teachers as the reason why learners enjoy it: Reasons given were that learners performed well in practical work "because they get involved in the lesson; and are responsible for their own learning" (Mlondolozi, CPQ6, 2BQ14) and "because they are doing the project themselves step by step and they could see the results" (Khuthala, CPQ7, 2BQ14).

4.3.4.5 Relevance of the course to teacher context

During a professional development program, teacher's knowledge of their classroom context and learners, cause them to filter or amplify aspects of the presented course in terms of how relevant for their own contexts, the course appears to be. In this course, twelve of the sixteen teachers found that the course content was very relevant to their needs, three found that it was mostly relevant and one that it was only sometimes relevant (Q2.4, REF). Understandably then, as the teachers were teaching in different contexts, the comments as to the aspect of the course that teachers found most useful, varied greatly with no particular pattern emerging: Six of the teachers mentioned the planning activities; two mentioned the mind-mapping

(*Activity 3*); two mentioned the use of a movie as a teaching strategy (*Activity 1*); and six made more general comments. Of the general comments, two teachers wrote of the applicability of the course to their context: "I was able to apply what I learnt from class" (Teacher A, REF, Q2.1) and "The course is so good it could be better if all other educators to attend because it does not only focus on one subject you can apply this to other subjects" (Teacher P, REF, Q2.1).

4.3.4.6 Resources available at school

Grangeat and Hudson (2015) refer to the instrumental context of the teacher as including access to teaching resources and materials (p. 220). Comments by teachers regarding access to resources tended to be incidental and appeared on occasion throughout the course. Only one teacher mentioned lack of resources in the form of stationary and apparatus as a specific challenge (Sonwabo, CPQ12, 2BQ12). However, when teachers were asked what key environmental concepts learners struggle with (2BQ15), a number of comments were made that refer to learners' lack of exposure to ideas such as: "Things they cannot relate to: Never saw, and have no idea about. Maybe they have no idea what 'something' is, because of lack of resources, exposure to it, etc." (Mlondolozi, CPQ6, 2BQ15/16). These comments also alluded to a lack of availability of resources as being one of the contributing factors to what might be termed a lack of 'general knowledge'.

During the first session in one of the recorded discussions, a group of four teachers were talking about the possibility of being able to show a video to their class. One of them indicated that they had access to a whiteboard (although it was broken), one had a working whiteboard, but used a data projector and laptop and the other two had no access to either forms of technology (TAT1G1, //164-168). In the reflection and evaluation form two teachers mentioned a lack of resources at their school with Teacher E commenting: "Teachers need resources. Most of the schools don't have resources, hence it's difficult to apply most aspects in real life situation" (Teacher E, REF, Q3.5). The presence or absence of resources can therefore have an amplifying or filtering effect respectively on the types of teaching strategies available to the teachers from a practical point of view. The statement by a teacher in the first session that if "you don't have resources in your class you have to improvise" (TM1//418-419), indicated how teachers adapt their teaching according to availability of resources.

4.4 The facilitators within the *Fundisa for Change Teaching Life & Living* course

According to Borko (2004), the tasks of the facilitator in a professional development system are firstly to plan the learning experiences using the resource materials in such a way as to realise the goals of the programme and secondly during course enactment, to create an atmosphere of mutual respect and trust among participants in which critical dialogue can occur (see Section 2.6.3). In addition, in a participant-observer type of situation, where the researcher becomes the "prime research instrument" (Yin, 2011, p. 123), the researcher needs to be cognisant of the influence of factors such as their own background, motives, amplifiers and filters on their understanding and behaviour in the field (Yin, 2011, p. 123). In this study, with myself being both the facilitator and the researcher, my positionality and experiential knowledge was made explicit, along with that of the other facilitator, Nomvuyo Mgoqi (see Appendix B).

In the section below, the two facilitators are introduced and our positionality and experiential knowledge made explicit. This is followed by a description of the influence we have had on the enactment of the course.

4.4.1 Facilitators' positionality and experiential knowledge

Maxwell (2008) recommended the creation of a researcher identity memo which "involves reflecting on, and writing down, the different aspects of your experience that are potentially relevant to your study" (p. 225) as a means to making experiential knowledge explicit. These relevant aspects of my and Nomvuyo's life experiences are summarised below. Additional biographical information is captured in more detail in Appendices B1 and B2 in the form of researcher identity memos.

Myself and my colleague, Nomvuyo Mgoqi, have worked closely together co-teaching teacher professional development workshops and short courses on a wide range of science- and environment-related topics over the past twelve years. Nomvuyo is one of the Science Education Specialists employed at the Schools Development Unit, UCT. Common to both of our attitudes to teacher professional development is a belief that teacher change is possible through engaging in purposeful dialogue around the curriculum.

Both Nomvuyo and myself were born in the early nineteen-sixties. During my primary schooling, I was exposed to two very different teaching styles: highly structured, streamed group work; and teacher-centred knowledge transmission. In my last year of primary schooling, I happened to read a magazine article about an alternative school called Summerhill run by A. S. Neill. I became fascinated by the idea of different schools with different teaching enabling different learning experiences and knew from that age on that I wanted to become a teacher. My first teaching post, in 1986, was at Langa High School, Cape Town, teaching Mathematics and computer literacy. This was followed by a year at Fish Hoek Middle School in the South Peninsula area of Cape Town, teaching Natural Science and Mathematics, after which I returned to Langa to the St. Francis Adult Education Centre where I worked for the next nine years having established a large computer centre focusing on computer literacy training for young adults. During this time I became involved in the Kommetjie Environmental Awareness Group (KEAG) and started to run 'Wild Weekend Workshops' on local environmental issues for teachers from all the South Peninsula schools. At the same time, I started my B.Ed(Hons) and chose to include in it an environmental education module.

Nomvuyo's journey into teaching began in the early 1990's, in a secondary school in the Eastern Cape. She taught at this school for three years with no teaching qualification because there was shortage of mathematics and science teachers. In 1994, she left the Eastern Cape and came to Cape Town to complete her B. Sc. After completion of this first degree, Nomvuyo had to work and was appointed as a post level 1 Physical Science teacher at a secondary school in Philippi, Cape Town. In her teaching practice she drew from one of her best science teacher's teaching strategies. Two years later she decided to enrol for a Higher Diploma in Education. This is where she met the renowned professor in science education, Prof. Ogunniyi. It was through the influence of this professor that she was introduced to different aspects of science education, learning styles and learning theories, different methodologies and approaches. This experience was an eye opener for her coming from Bantu education and her beliefs or orientations, not only in teaching sciences but of schooling in general, changed completely.

Nomvuyo and I have both been working for the Schools Development Unit (SDU) at UCT for many years with Nomvuyo joining in 2003 as an Education Specialist (Sciences) and my

employment consisting of ad hoc project work in Mathematics and Natural Science since 2004. Nomvuyo has worked in many different SDU projects, including teaching university endorsed short courses, doing school-based support and teaching formal qualifications such as the General Education and Training Band, Advanced Certificate in Education and Advanced Certificate in Teaching, and the development of quality teaching and learning materials, including online resources. My work at the SDU has typically entailed either developing teacher resources including textbooks, teaching in-service teachers or a combination of both. This type of work has afforded me the opportunity to experience diverse teaching contexts in a variety of South African schools. The question of how best to structure and deliver in-service teacher professional development to maximise learning within the budgetary constraints of projects and the practical issues around availability of teachers, has always been a point of much debate amongst my colleagues. This research has provided me with an opportunity to investigate teacher learning within a professional development context.

In 2008, both Nomvuyo and myself started work on the Climate Change Education and Awareness Project for Secondary Schools, funded by the Department and Environment and Development Planning. This project involved the development of materials and teacher training on the environmental content around climate change across the curriculum. In 2013, we were excited and inspired by the *Fundisa for Change* Programme and became involved in furthering our studies in environmental education.

From a professional development perspective, when Nomvuyo and I are co-facilitating, we try to underplay the teacher-learner power relationship by treating teachers as equals, with respect and as professional individuals, focusing on the common goal of facilitating quality education. Inherent in these decisions is our belief that knowledge can be both individual and socially constructed and that effective learning should be learner-centred.

In teacher reflections on the best aspect of the course facilitation, of the 14 comments, half related to aspects that alluded to a positive learning environment or atmosphere of the course. Some examples are:

> "Interactive way of engagement on topics" (Teacher D, REF, Q2.12).
>
> "Engaging us in planning lessons" (Teacher C, REF, Q2.12).

"The use of appropriate methods and approaches" (Teacher G, REF, Q2.12).

"To group us and then we will take turns to present what we have done as a group" (Teacher I, REF, Q2.12).

4.4.2 Facilitators' influence on course enactment

Just as the teacher's amplifiers and filters affect the likelihood of a teacher accepting strategies for classroom practice, so the facilitators' amplifiers and filters, in the form of beliefs, attitudes, orientations, prior knowledge and context, affect the facilitators' enactment of the professional development course. Appendix O presents a table comparing the activities as they were enacted in the *Fundisa for Change Teaching Life & Living* course with the course activities as described in the *Fundisa for Change Introductory Core Text*. As mentioned in Section 3.5.2, the data source for describing the enactment made use of the observation forms based on the video-recordings of the sessions (S1OBS: VT1 – S5OBS: VT3). In addition, the table in Appendix O also gives detailed reasons for the adaptation or omission of activities. These reasons, summarised below, reflect the informal discussions between Nomvuyo and myself in planning for the enactment in our context. Throughout these discussions we were very aware of maintaining the integrity of the *Fundisa for Change* original goals (see Section 2.6.3).

In the course enactment, some of the *Introductory Core Text* activities were adapted due to a differing perceived need or focus by the facilitators. For example, the activity on the environment content in the CAPS included an examination across subjects whereas Nomvuyo and I felt a need to focus specifically on the CAPS for Natural Sciences but for both Intermediate and Senior Phase and to map progression of environmental concepts across the grades. In another instance, Nomvuyo and I decided to expand on the existing *Introductory Core Text* activities on assessment. We felt that teachers needed more opportunity to discuss different types of assessment and their purposes and to be given exposure to examples that modelled how assessment could be used to inform teaching, not just assess learning. In addition, we wanted to develop teacher understanding of cognitive demand of questions. To this end, we included an activity where teachers used the revised Bloom's Taxonomy Tables to identify the knowledge and cognitive dimensions of environmental learning objectives from the CAPS. Other of the *Introductory Core Text* activities were adapted due to resource or time constraints. Two of the activities required internet access which we did not have

available in the course venue. In one instance this was overcome through the use of a pre-downloaded YouTube video and in the other, the activity was left out. Another activity required that teachers would have to read an entire booklet. The booklet was rather summarised into a two-page list form to save on reading time.

Another influence, past experience, is explained in the extract from the researcher identity memo below:

> Past experience plays a large part in how I plan to present the *Fundisa for Change* courses. I shift the focus according to the time of year and what is to be taught still, according to what phase the teachers are teaching, and according to what aspects of the activities worked well the last time.
>
> (Researcher identity memo, Appendix B)

The adaptations described above, often influenced by past experience, indicate how a facilitator's PCK could serve to amplify or filter the activities as they plan the structuring of the sessions and learning experiences of the course.

4.5 Summary

This chapter concludes the data presentation relating to Phase 2 of the analysis that addresses both Sub-Question 1 and Sub-Question 2. The chapter gave a detailed description of the elements of the *Fundisa for Change* teacher professional development system, namely, the professional development programme, teachers and facilitators and their respective contexts. This included the enactment of the course with teacher's reflections on the activities, the role of the facilitators, the teachers, and the course context.

Chapter 5 Discussion

5.1 Introduction

This study focused on the support and construction of the development of environmental PCK in a *Fundisa for Change* teacher professional development course. In Chapter 4, data was presented to show how the *Fundisa for Change Teaching Life & Living* course operated as a professional development system. Amplifiers and filters affecting the development of teacher PCK in the system were also identified. This chapter, supported by the analysis done in Chapter 4, identifies the environmental PCK emerging from the course to answer the research question asked in Chapter 1: How is the development and emergence of environmental pedagogical content knowledge supported and constructed in the *Fundisa for Change* teacher professional development course?

The chapter starts by briefly revisiting the definition of teacher PCK and professional knowledge. This is followed by an examination of the emergent PCK from the *Fundisa for Change Teaching Life & Living* course and how it was affected by the amplifiers and filters operating through the context, beliefs and orientation and prior knowledge of this group of teachers.

5.2 Pedagogical content knowledge and teacher professional knowledge

This study has been informed by the PCK research work consolidated by and emanating from the 2015 PCK Summit (see Section 2.2) but with its origins in the work of Lee Shulman (1986; 1987). The resultant PCK definition, and the one used for this study (see Section 2.2.1), was:

> - Personal PCK is the *knowledge* of, *reasoning* behind, and *planning* for teaching a particular *topic* in a particular *way* for a particular *purpose* to particular *students* for enhanced *student outcomes* (Reflection *on* Action, Explicit).
> - Personal PCK&S is the *act of teaching* a particular *topic* in a particular *way* for a particular *purpose* to particular *students* for enhanced *student outcomes* (Reflection *in* Action, Tacit or Explicit).
>
> (Gess-Newsome, 2015, p. 36)

Key to this definition was that PCK was portrayed as personal knowledge derived from general and topic-specific professional knowledge bases as they interact with classroom practice. With the emphasis of this study on the potential for development of personal environmental PCK during the *Fundisa for Change* course, the first part of this definition received more focus. The relationship between PCK and the teacher professional knowledge bases was conceptualised using the Summit Consensus model (see Section 2.2.2), another of the outputs from the 2015 PCK Summit (see Figure 2.1). In the *Fundisa for Change Teaching Life & Living* course, the professional knowledge revolved around environmental understanding: at a general level in the form of important core concepts; at a Natural Sciences senior phase subject level; at the domain level of the *Life & Living* knowledge strand; and, at the topic-specific level of the individual topics making up the *Life & Living* knowledge strand. The Summit Consensus model also indicated the role of the filtering or amplifying powers of teacher beliefs, orientations, prior knowledge and context as mediating the transformation of professional knowledge into PCK.

5.3 PCK emerging from the *Fundisa for Change* course

As proposed in Chapter 2 (see Section 2.4), five components of PCK were identified from the literature for this study. These were:

- Assessment knowledge
- Pedagogical knowledge
- Content knowledge
- Knowledge of learners
- Curricular knowledge

The main sources of evidence of emergent PCK were the transcribed audio-tapes of group discussions during the five sessions where the teachers were reasoning through the content (TAT1G1 – TAT5G4), the activity outputs (see Table 3.8) and the reflection and evaluation forms (REF1 – REF16). Throughout the course, teachers were given the opportunity to co-construct their knowledge through collaborative discussion (see Section 4.2.2.2). As suggested by Borko (2004), in the enactment of the course, the facilitators attempted to be consistently approachable and responsive to the teachers and discussions (see Section 2.6.3).

Descriptions of the evidence of pedagogical reasoning and emergent PCK for each of the PCK components is now presented and discussed.

5.3.1 Assessment knowledge

Assessment knowledge refers to knowledge of ways to draw out and evaluate learner thinking both formatively and summatively (see Section 2.4.1). The improvement of assessment practice was one of the three focus areas of the *Fundisa for Change* courses (see Section 4.2). The *Fundisa for Change Introductory Core Text* stated that "good assessment practice greatly enhances the quality of teaching practice, especially if assessment is seen as an important part of the learning process" (Fundisa for Change Programme, 2013, p. 16). The development of assessment knowledge in the *Fundisa for Change* course was skills-based at a general, subject and topic-specific level. The aspects and strategies for assessment developed in the course are listed in Table 5.1 below along with the activity/ies in which the aspect was developed and a brief description of the activity context.

Table 5.1 Aspects of assessment knowledge developed in particular activities

Aspect of assessment knowledge	**Activity in which the assessment knowledge was developed**	**Description of the activity context**
Formative assessment strategies such as using rubrics to provide feedback	*Activity 6 'The water cycle'*	This group activity developed the general use of a rubric to give formative feedback using the topic-specific example of the water cycle. The activity also modelled peer assessment as groups of teachers assessed each others diagrams.
Understanding the purpose of formative as against summative assessment	*Activity 8 'Assessment discussion'* *Activity 9 'Assessment vignettes'*	This group activity aimed to establish teachers' general understanding of the purpose of assessment and the difference between assessment of and assessment for learning. This activity aimed to clarify the purposes of assessment, in particular the use of formative assessment to further learners' conceptual understanding
Establishing cognitive levels of both formative and summative assessment tasks	*Activity 10 'Assessment of environmental learning in CAPS'*	This activity focused on the use of the revised Bloom's Taxonomy Tables to establish the cognitive levels of the environmental learning in the CAPS for different grades.

The assessment knowledge learning by the teachers on each of these aspects is now discussed.

Development of knowledge of formative assessment strategies

The *Introductory Core Text* specifically refers to the importance of the formative assessment strategies of providing feedback to learners and eliciting information on learners' learning for the purpose of further learning support (Fundisa for Change Programme, 2013, p. 16). One of the ways in which these strategies can be implemented is through the use of a rubric. The sharing with learners of the criteria for success and the subsequent provision of feedback relating to these criteria (Leahy and Wiliam, 2012) is viewed as an effective formative assessment strategy (see Section 2.4.1).

Formative assessment through use of a rubric as a tool to give constructive, criteria-based feedback, was the assessment knowledge focus in the *Teaching Life & Living* course in *Activity 6 'The water cycle'*. Teachers, working in groups, created diagrams showing the flow of a water drop through Earth's systems. The groups were then asked to use a rubric formatively by marking another groups' work and giving constructive feedback. Groups were given additional prompting from the facilitators to add to their initial feedback to include task-related feedback that referred directly to the rubric criteria and could be considered formative in that it could guide improvement. Thus, for example, Group 4's initial comments on Group 1's diagram of "impressive" and "work neatly and clearly" were then supplemented with the task-related comment "always make sure that [there are] no unidentified arrows". Group 2 made the initial comment of "very neat work" on Group 4's work that was later supplemented with "the cycle is incomplete" and "use scientific terms preferably" (see Table 4.2). Through the differentiation of feedback into task-related and personal- or overall-performance-related comments, teachers appeared to understand how the former could be used to advance learner performance (see Activity 6, Section 4.2.1). On the reflection and evaluation form, four of the twelve comments reflected on the personal learning about the use and purpose of a rubric and feedback for formative assessment. The teacher PCK learning with regard to formative assessment, as evidenced in these reflections, centred on how a well-thought-out rubric could enable them to evaluate against specific criteria and track learners' learning.

Although the teachers recognised the effectiveness of feedback to lead to learner improvement, some expressed in a later group discussion that the time pressures of the CAPS made the practicalities of implementing formative assessment strategies, such as giving

learners feedback on tasks, unrealistic (see Section 4.3.3). Thus, time pressure created by the allocation of time to topics in the CAPS was seen as a filter to the use of feedback as a formative assessment strategy.

Understanding the differing purposes of assessment of learning and assessment for learning

As part of the development of general assessment knowledge development in the *Fundisa for Change* course, teachers were given the opportunity to discuss the differences between assessment *of* learning (summative assessment) and assessment *for* learning (formative assessment). In *Activity 8 'Assessment discussion'* the purpose was to establish teacher's prior knowledge of assessment and to initiate discussion about assessment. Teachers discussed a series of questions, one of which was 'What are the differences between assessment of learning and assessment for learning?' The descriptions of assessment for learning given by two of the four groups as "teacher-based, to support the child" and "an assessment where they [learners] will learn while doing it [the assessment task]" (see Table 4.4) did not include how formative assessment could be used by teachers to make decisions about the next steps required to move learning forward. For this reason, the facilitators decided to include an additional activity, *Activity 9 'Assessment vignettes'* with the aim of clarifying this defining purpose of formative assessment. Teachers were given a series of four vignettes to discuss, each illustrating a different formative or summative assessment practice. Through their discussion, teachers seemed to begin to make sense of using formative assessment not only to plan subsequent learning, thereby furthering learners' conceptual understanding, but also as a means of self-evaluation of the effectiveness of their teaching methods with a view to adapting the way they teach the same material a second or third time (see Activity 9, Section 4.2.1).

Establishing the cognitive levels of the environmental learning in CAPS

The Natural Sciences CAPS requires that teachers ensure that their assessments are "appropriate to the age and developmental level of the learners in the grade" (South Africa. DBE, 2011, p. 66) in terms of cognitive demand. In *Activity 10 'Assessment of environmental learning in CAPS'* of the *Teaching Life & Living* course, teachers were introduced to the revised Bloom's Taxonomy Tables as a tool to classify learning objectives according to their

cognitive process and knowledge dimensions (see Section 4.2.1). Although knowledge of the tool would form part of general pedagogical and assessment knowledge, the tool was applied in this case to develop topic-specific assessment knowledge. The teachers' conversations illustrated their engagement with understanding how to work out the knowledge and cognitive dimensions of objectives, thereby developing this aspect of their assessment knowledge. None of the teachers had worked with the revised Bloom's Taxonomy tables before but all were aware of the cognitive level requirements for summative assessment in the CAPS. The discussions gave them the opportunity to collaboratively create an understanding of the knowledge and cognitive dimensions of the revised Bloom's Taxonomy.

Feedback given by the teachers at the end of the session (see Activity 10, Section 4.2.1) appeared to reflect an increased awareness of the amount of thinking about questions required in setting up assessments, with regard to the cognitive demand of the questions. The process of checking the cognitive levels of questions was, however, seen as time-consuming within an already time-pressured curriculum. Other teachers felt that the language level of learners impacted on the way in which they structured their assessments. One teacher felt that his desire for learners to pass made him avoid questions with higher cognitive demand. Another teacher explained that he avoided questions requiring lengthy writing but rather asks learners to provide point-form factual answers. However, this strategy would mostly result in a lowering of the cognitive demand of questions. Another teacher suggested providing a framework to make the meanings of the action verbs, such as 'describe' and 'explain', explicit. This strategy was acknowledged as providing scaffolding to learners. Thus, teachers' time pressure and learners' language ability were seen as impacting on both the form and cognitive demand of assessment tasks (see Section 4.3.3.2 and 4.3.3.4).

5.3.2 Pedagogical knowledge

Pedagogical knowledge at a general and subject level includes effective instructional strategies for teaching difficult concepts and for overcoming misconceptions (see Section 2.4.2) by "reorganizing the understanding of learners" (Shulman, 1986, p. 10). The activities in the course that supported the development of "an instructional repertoire" (Shulman, 1987, p. 15) are listed in Table 5.2 below along with the aspect of pedagogical knowledge developed and a brief description of the activity context. Also included as pedagogical knowledge but at a topic-specific level, is knowledge of the content representations used

within a topic. The teacher learning of pedagogical knowledge including that of content representations is now discussed.

Table 5.2 Aspects of pedagogical knowledge developed in particular activities

Aspect of pedagogical knowledge	**Activity in which the pedagogical knowledge was developed**	**Description of the activity context**
Strategy of listening with intent	*Activity 1 'Movie'*	This activity modelled the general pedagogical strategy of active listening. Teachers discussed how they could adapt and use this strategy in their own teaching contexts.
Supporting language and vocabulary development	*Activity 2 'Build a better world'*	This activity modelled the use of discussion of concepts to ensure everyone has a common understanding.
Content representations to scaffold conceptual development	*Activity 3 'Life & Living: Ecology in the CAPS'*	This activity involved the representation of ecology concepts as a mind-map, creating a diagrammatic 'picture' of the CAPS.
	Activity 6 'The water cycle'	The purpose of this activity was to represent the water cycle in different ways: first as a paragraph of text; and, secondly as a diagram showing the path of a drop of water through earth's spheres (hydrosphere, pedosphere, atmosphere and biosphere).
	Activity 7 'Big ideas and lesson planning'	In this activity, teachers consider how to transform the content through the processes of selection and representation as they select and order the instructional strategies they would use in their teaching.
Matching teaching strategies with educational purpose	*Activity 4 'Exploring teaching methods'*	In this activity, teachers read brief descriptions of a variety of generic teaching methods. The purpose was to remind teachers of the variety of instructional strategies that exist.
	Activity 5 'Evaluating the sequence of methods used in a programme of learning'	In *Activity 5* teachers identified teaching strategies in a vignette of a programme of learning and then linked them to educational goals and purposes.

Strategy of listening with intent

'Listening with intent' is a generally-applied teaching strategy (Fundisa for Change Programme, 2013, p. 10). The strategy involves the creation of a situation of purposeful listening through making the teaching goals and expectations explicit. The strategy was

modelled in *Activity 1 'Movie'*. The teachers applied pedagogical reasoning processes as they selected and ordered aspects of the 'listening with intent' strategy of providing clear instructions at the outset of the activity to explain the criteria for successful completion. As part of the activity, teachers discussed the impact that knowing the structure and requirements of the activity had on their learning. They reported that their attention became more focused on the task as they knew what was expected of them. Through the discussion, teachers appeared to understand that there were positive consequences for learning by receiving the criteria for the successful completion of the activity at the start of the activity to stimulate listening with intent. In addition, on the course evaluation and reflection form, a third of the teachers reflected that the 'listening with intent' strategy would motivate their learners to listen actively and enable them to respond better to assessment questions. As a general teaching strategy, 'listening with intent' can be applied to a variety of teaching contexts. This transferability was supported by comments from the teachers on the reflection and evaluation form indicating that they could apply 'listening with intent' as a strategy to other topics and subjects.

Supporting language and vocabulary development

In *Activity 2 'Build a better world'* teachers were given the opportunity to discuss the definitions of words often encountered when referring to environmental and sustainability education. Through discussion, teachers were able within their groups, to come to a common understanding of the following terms: Equity; Sustainability; Resilience; Adaptation; and, Transformation. As stated in the *Introductory Core Text*, "successful 'listening with intent' approaches require adequate vocabulary, so that learners can understand what is being said." (Fundisa for Change Programme, 2013, p. 10). Although the focus in this activity was on teacher conceptual development, teachers recognised discussion of word definitions as a useful generic teaching strategy for language and vocabulary development. Language and science terminology in particular, were mentioned by teachers both in the contextual profile questionnaire and during the course as important but time-consuming to teach due to many classes having high percentages of learners with their first language different from the language of instruction (see Section 4.3.4.4).

Use of content representations to scaffold conceptual development

Pedagogical knowledge at a topic-specific level also includes the use of effective content representations. Content representations refer to the commonly used ways of representing ideas and concepts that are particular to the topic (see Section 2.4.2) and form part of a teacher's "representational repertoire" (Shulman, 1987, p. 16). Two activities exposed teachers to different content representation strategies for both general and environmental topics. These activities involved the translation of environmental content from one form into another: from text to mind-map in *Activity 3 'Life & Living: Ecology in the CAPS'*; and, from cyclical diagram to text and then into a different diagrammatical form in *Activity 6 'The water cycle'* (see Section 4.2.1).

The mind-maps produced by the groups of teachers in *Activity 3*, differed considerably in terms of organisation of concepts into an easily readable and understandable form. One group organised the concepts into topics and then wrote all the grades in which that topic was taught, next to the topics. Another group battled to find structure for the concepts with only a few topic headings and one grade heading and many of the concepts remaining unallocated. The third group attempted to link all the concepts but did not use any headings to add structure. The fourth group organised concepts according to grade, with topic headings as subheadings under the grades (see Figure 4.2). In the reflections on *Activity 3*, mind-mapping was mentioned as a useful tool for scaffolding conceptual development and for checking that learners had summarised concepts correctly for a section of content.

The water cycle is a familiar example of a topic-specific content representation. It was interesting to observe that two of the four groups found it challenging to write sentences in isolation but rather incorporated them into a diagram (see Appendix K). The second part of the activity involved another translation of the water cycle – this time into a diagram showing the path of a drop of water through earth's spheres (hydrosphere, pedosphere, atmosphere and biosphere). In their reflections, one teacher commented on how the use of a different content representation caused confusion initially, while others commented on how their thinking had been stimulated and challenged through the strategy of changing the content representation from one form to another.

In *Activity 7 'Big ideas and lesson planning'*, teachers were required to plan a series of lessons on an environmental topic using the CoRe template. The CoRe template question designed to elicit topic-specific PCK around pedagogical knowledge was: What teaching procedures would you use, and why, for this idea? (see Table 3.6). In answering this question, reference was expected to be made to both content representations and teaching strategies. Teaching strategies are considered first, followed by content representations.

During the selection process of planning for teaching (see Section 2.5.2), teachers purposefully choose teaching strategies best suited for presenting the particular content knowledge. The activities suggested in the Gr 6 CoRe on the topic of Ecosystems and food webs, show a variety of teaching strategies selected for different purposes as well as evidence of encouraging learner involvement, through the use of the following verbs in their descriptions: "exploring", "listening", "reading", "drawing", "identifying" and "describing" (CoReGr6). The activities also supported the sequencing of the 'Big ideas'. The lesson plans for this topic (see Appendix N, LPGr6T1 and LPGr6T2) suggested an outdoor investigation followed by a discussion for the 'Big idea: Living and non-living things in an ecosystem', and a role play followed by a worksheet for the 'Big idea: In an ecosystem plants and animals are connected by their feeding relationships'.

For the Gr 7 CoRe on the topic of Variation, the teaching strategies suggested showed some sequencing related to the 'Big ideas', were diverse and actively involved the learner in measuring and collecting data. The content representations selected for this topic were histograms and bar graphs. In the discussions during this activity, there was some evidence of teachers sharing understanding of teaching strategies and their purposes (see Activity 7, Section 4.2.1). Teachers in this group also took the opportunity towards the end of this session, to discuss and share with each other the various practical activities they had done with their classes that term. These discussions described in detail what the learners would be doing, their teaching strategies, the conceptual progression from Grade 4 to Grade 7 and, in one case, how they were marked as well. The Grade 6 group in their discussion on teaching strategies and content representations, were not explicit about the purposes. Tables with photographs of different ecosystems and drawings of food webs are suggested but these ideas are listed without specific mention made as to how the representation helps to illustrate the concept. The Grade 7 teachers suggest content representations in the form of graphs but the links with the 'Big ideas' were not explained. In the group discussions, there was minimal

mention of content representations. However, a Grade 7 teacher in answer to the question 'How would you ascertain learner understanding?' proposed the use of pictures to overcome confusion about the 'Variation' topic.

Matching teaching strategies with educational purpose

To develop the link between teaching strategies and educational purpose, teachers were first asked in *Activity 4 'Exploring teaching methods'* to read brief descriptions of a variety of generic teaching methods and to consider the relevance of the methods to their subject. The purpose was to remind teachers of the variety of strategies that exist as "a broader range of different kinds of methods generally helps us to address a broader spectrum of environmental learning outcomes" (Rosenberg, O'Donoghue, & Olvitt, 2013, p. 3). The strategies listed were also grouped according to their educational purpose or intent such as 'Experiential methods' or 'Deliberative methods'. Teachers completed this activity individually by indicating how often they had used a particular method over the previous year. In the feedback immediately after the session, one group of teachers gave as the reason why they did not use a variety of methods, the assessment focus of the curriculum (see Activity 4, Section 4.2.1). On the reflection and evaluation form, the majority of teachers' reflections acknowledged that different methods served different purposes and that some could be used to make lessons more interactive and help them to plan with purpose and coherence.

The second activity focussing on the link between strategy and purpose was *Activity 5 'Evaluating the sequence of methods used in a programme of learning'*. Teachers worked in groups to analyse a vignette of a series of activities on a topic to identify the activity, the goal or purpose of the activity and the teaching strategy used (see Activity 5, Section 4.2.1). In this way, teachers had to make the link between teaching methods and the different purposes they serve, explicit. This activity focused on general teaching strategies, thereby developing knowledge of instructional strategies at a general level. One group, as evidenced by their table, found it difficult to distinguish the learning goal from the teaching strategy at first. They also found it difficult to identify the individual activities making up the lesson, identifying only four of the seven activities. Two of the other groups identified five activities and one group identified all seven activities, each with their own distinct purpose and teaching strategy. Teacher learning from this activity indicated an understanding that learning goals can be achieved using different teaching methods. Comments arising during the class

feedback varied from seeing the potential of using a variety of teaching methods to keep the interest of learners to anticipating problems with implementation due to class size (see Section 4.3.4.3). Another problem, raised during group discussions on topic planning in *Activity 7*, was that there was not enough time allocated for practical work despite practical work being recognised as motivating learners (see Section 4.3.4.4). Another filter to the use of different teaching methods mentioned was a lack of resources (see Section 4.3.4.6).

5.3.3 Content knowledge

Content knowledge refers to the knowledge generation methods, core ideas and concepts of a subject (Gess-Newsome, 2015) (see Section 2.4.3). In the *Fundisa for Change Teaching Life & Living* course, the environmental content knowledge was predominantly co-constructed by teachers through the collaborative discussions within groups (see Section 4.2.2.2). Shulman (1987) describes content knowledge (CK) as "the first source of the knowledge base" (p. 14) for teaching, and argued that "to teach is first to understand" (p. 14). This process of comprehension also underpins the further processes of pedagogical reasoning (see Section 2.5.1). Research appears to indicate a positive correlation between teachers' CK and PCK (see Section 2.2.2). In addition, teachers are more able to assess topic-specific learning if they have a strong content knowledge and understanding of the learning processes involved (Shulman, 1987).

The development of environmental content knowledge was a key aim of the *Fundisa for Change* programme. The conceptual framework of the *Fundisa for Change* courses was designed to "consist of 'core' (relevant across subjects for all subject teachers in all phases), and 'specific' (relevant to specific topics or topic areas)" (Lotz-Sisitka, 2011, p. 56) environmental knowledge. The aspects of content knowledge developed in the *Fundisa for Change Teaching Life & Living* course are listed in Table 5.3 below along with the related activities and a short reminder of the activity context. Teacher learning of content knowledge is now discussed.

Table 5.3 Aspects of content knowledge developed in particular activities

Aspect of content knowledge	**Activity in which the content knowledge was developed**	**Description of the activity context**
Biodiversity key ideas	*Activity 1 'Movie'*	This activity developed the understanding of biodiversity through the watching of a movie and subsequent discussion.
	Activity 7 'Big ideas and lesson planning'	This activity aimed to draw out teachers' topic- and grade-specific environmental knowledge.
Core environmental knowledge	*Activity 2 'Build a better world'*	This activity developed general core environmental knowledge in the form of key definitions.
Earth's water cycle as a system	*Activity 6 'The water cycle'*	This activity aimed to develop a deeper understanding of the water cycle and its vulnerability as a system to human interference.

Biodiversity key ideas

Biodiversity is a key concept in the CAPS Intermediate Phase *Life & Living* strand. The biodiversity key ideas introduced in this activity were:

- Biodiversity is made up of an intertwining of ecosystem diversity, species diversity and genetic diversity.
- The more bio-diverse an ecosystem is, the more resilient to change it is.
- Loss of keystone species can threaten an entire ecosystem.
- Humans depend on biodiversity and our survival can be threatened by biodiversity loss.

These key ideas also have some overlap with the foundational environmental knowledge described in the *Fundisa for Change Introductory Core Text* as including:

> - The Earth as a system;
> - Key life supporting processes; and,
> - How ecosystems function to support the diversity of life. (Fundisa for Change Programme, 2013, p. 8)

The teacher learning on biodiversity key ideas that emerged from *Activity 1*, as evidenced from discussions, centred on the inter-dependance of species within an ecosystem and the importance of diversity for resilience of ecosystems under threat (see Activity 1, Section 4.2.1). Roughly one quarter of the teacher reflections were comments related to the content

knowledge focus of the activity. However, these comments tended to refer to general learning about biodiversity rather than to mention specific key concepts.

Core environmental knowledge

Teachers' conceptual development of core environmental knowledge was the aim of *Activity 2 'Build a better world'*. Teachers were required to jointly define concepts related to the environment, sustainability and social justice: transformation; equality; adaptation; resilience; and sustainability. They were also required to give an example of a social practice that expressed the meaning of the concept and explain the relevance of the concept for education in general and their subject in particular. Teacher discussion for this activity centred on the clarification of meanings as teachers built up a common understanding of the concepts. More than half the teachers reflected on the positive development of their own learning and understanding for this activity. Teacher learning of core environmental knowledge appeared to involve a broadening of understanding beyond the definitions as the often-subtle differences between the concepts became clearer and misunderstandings could be clarified (see Activity 2, Section 4.2.1).

Earth's water cycle as a system

A third content knowledge focus area was the Earth's water cycle as a system. Foundational environmental knowledge of the Earth as a system was developed in *Activity 6 'The water cycle'* which aimed to deepen teacher understanding as they translated their knowledge of the water cycle from one form into another (see Activity 6, Section 4.2.1). Teachers shared and developed their understanding of Earth's water cycle as a complex system of interacting spheres as they translated the content from one representation to another. The strategy of changing the content representation from one form to another appeared to develop teachers' content knowledge. There appeared to be much clarification of the water cycle as teachers attempted to describe in full sentences what was happening in the cycle. Following a water drop through Earth's systems again involved a re-organisation of understanding, evident in the discussion extracts quoted in *Activity 6*, Section 4.2.1, as teachers related the water cycle processes to water's movement between the biosphere, hydrosphere, atmosphere and

pedosphere. The human impacts raised by teachers during discussion included pollution from industry, deforestation, acid rain, irrigation for farming and water wastage.

5.3.4 Knowledge of learners

The transformative process of adaptation (see Section 2.3.2) where learner thinking and prior knowledge are taken into consideration, builds the 'Knowledge of learners' component of PCK at a topic-specific level. Expert teachers use their understanding of conceptions and misconceptions for a particular topic "to shape the manner in which they teach particular concepts and topics" (Loughran et al., 2012, p. 18). In order to counter known areas of difficulty for a topic, a teacher would potentially be drawing on general pedagogical knowledge, conceptual teaching strategies, content knowledge and the curriculum knowledge components of PCK. Establishment of learners' prior knowledge is important in understanding the progression of their conceptual development and potential sources of misconceptions. There were two activities that explicitly asked the teachers to consider their learners, as indicated in Table 5.4 below, but the teachers often incorporated various aspects of knowledge of their learners into their discussions at different times during the course. Each aspect is now discussed.

Table 5.4 Aspects of knowledge of learners developed in particular activities

Aspect of knowledge of learners	**Activity in which the knowledge of learners was considered**	**Description of the activity context**
Adapting teaching to particular learners	*Activity 1 'Movie'*	This activity gave teachers the opportunity to consider how they would adapt the teaching strategy for use with their learners and within their context.
	Activity 7 'Big ideas and lesson planning'	This activity asked teachers questions on how knowledge of learner thinking influences their teaching of a topic and why a topic can be difficult to teach.
Taking prior knowledge into consideration	*Activity 1 'Movie'*	Teachers suggest the establishment of prior knowledge of biodiversity at the start of the lesson.
	Activity 7 'Big ideas and lesson planning'	Teachers recognize the prior knowledge necessary for particular topics

Adapting teaching for particular groups of learners

In *Activity 1* teachers are asked to adapt the 'listening with intent' activity for use with their own learners. One of the groups suggested in their discussion that learner prior knowledge should be established and that the movie clip be shown twice as the speed of the narration and American accent of the narrator may make it difficult for learners to follow, especially for those not having English as a first language (see Activity 1, Section 4.2.1).

Again as part of *Activity 7 'Big ideas and lesson planning'*, teachers were asked to discuss how they would adapt teaching to their learners. Discussion centred on the following three questions related to the knowledge of learners component of PCK (see Table 3.6):

- What difficulties/limitations are connected with teaching this idea?
- What do you know about learner thinking which influences teaching about this idea?
- Are there any other factors that influence your teaching of this idea?

These questions created the opportunity for teachers to consider the contextual and conceptual issues that make a topic difficult to teach, drawing on their previous experiences of how learners learn.

The Grade 6 group referred to the contextual limitations of time and resources and how these factors would impact on their teaching of specific concepts. As noted in Section 4.3.3, contextual issues such as these may act as amplifiers and filters to teacher learning and classroom practice. This group also identified the complexity of food webs in an ecosystem as problematic to teach and noted several areas of difficulty relating to learners' conceptual understanding such as differentiating between living and non-living things, between food chains and food webs, and understanding the role of producers. In the Grade 7 group's discussion, a number of topic-specific contextual issues were identified as impacting on teaching about variation as a result of sexual reproduction of a species: Lengthy, time-consuming discussions as a result of the diversity of cultural and religious beliefs amongst learners; attitudes and preconceived ideas from home; and, sensitivity required when a learner in the class is pregnant. Difficult concepts were identified as genetics and inheritance. Those groups that identified conceptual difficulties did not elaborate in terms of how these were overcome. The questions asked in the activity would need additional modelling and

scaffolding, for their aim as surfacing teachers' understanding of their learners thinking and how this impacts on their teaching, to be realised.

Taking prior knowledge into consideration

Together with understanding the difficulties learners experience with particular concepts, establishing learner prior knowledge also plays an important role in quality teaching. As mentioned in Section 2.4.4, when teachers take into account their knowledge of learners, it enables their teaching to be more responsive to learner processes of constructing their knowledge (Loughran et al., 2012). The teachers on the course were all familiar with the strategy of establishing learner prior knowledge at the start of a new section of work or lesson, making reference to it at different times during the course (see Section 4.6.4). Group 1 in discussing *Activity 1* mention the importance of the establishment of prior knowledge of biodiversity at the start of the lesson and in the Grade 7 group discussion on 'Variation' in *Activity 7*, the previous topic of human reproduction was recognised as providing relevant prior knowledge (see Activity 7, Section 4.2.1).

5.3.5 Curricular knowledge

Curricular knowledge (see Section 2.4.5) refers to the understanding of how concepts of a particular topic are developed and sequenced as they form part of the discipline as a coherent whole (Gess-Newsome, 2015). Curricular knowledge, underpinned by the comprehension of concepts, plays a crucial role as a starting point for pedagogical reasoning processes (see Section 2.5.1). Teachers "should understand how a given idea relates to other ideas within the same subject area and to ideas in other subjects as well" (Shulman, 1987, p. 14). Aspects of curricular knowledge were developed explicitly in three of the activities, listed below in Table 5.5 along with the related activities and a short reminder of the activity context. Teacher learning of curricular knowledge is now discussed.

Table 5.5 Aspects of curricular knowledge developed in particular activities

Aspect of curricular knowledge	**Activity in which the content knowledge was developed**	**Description of the activity context**
Conceptual progression	*Activity 3 'Life &Living: Ecology in the CAPS'*	This activity developed domain-specific curricular knowledge of conceptual progression of environmental topics across Grades 4 – 8 for the *Life & Living* strand.
Conceptual development and sequencing	*Activity 7 'Big ideas and lesson planning'* *Activity 10 'Assessment of environmental learning in CAPS'*	This activity aimed to draw out teachers' topic- and grade-specific knowledge of conceptual progression. This activity developed teachers knowledge of topic-specific assessment tasks in the CAPS and how they link to conceptual progression.

Conceptual progression

In *Activity 3*, teachers created a mindmap of ecology keywords, tracing the development of environmental concepts within the *Life & Living* strand from Grade 4 through to a Grade 8 level (see Activity 3, Section 4.2.1), thereby focusing on curricular knowledge at a domain level. Curricular knowledge was evident when teachers showed comprehension of subject matter structures such as topic and conceptual progression (see Section 2.3.1). Evidence from group discussions indicated that this activity gave teachers an opportunity to become more familiar with how concepts were developed in the grades other than the grade they taught. Teachers appeared surprised at the extent of the development of environmental concepts in the *Life & Living* strand. On the reflection and evaluation form, more than half of the teachers reflected on how this activity enabled them to see the links between environmental concepts across the grades. An advantage mentioned of knowing how a concept was developed was that teachers would also be able to know what prior knowledge should be in place.

Conceptual development and sequencing

During the preparation phase of planning for teaching, curricular knowledge is evident when teachers transform content knowledge by re-structuring it into 'lessons' to align with their goals and purposes (see Section 2.5.2). Both *Activity 7* and *Activity 10* worked with conceptual development and sequencing at a topic-specific level, within the *Life & Living* strand. In *Activity 7*, teachers completed a planning activity using the content representation

template or CoRe of topic-specific 'Big Ideas' (see Activity 7, Section 4.2.1). In both the Grade 6 group working on the topic 'Ecosystems and food webs' and the Grade 7 group working on the topic 'Variation', the 'Big ideas' for the conceptual development of the content to be taught was presented in a logical and progressive manner. The other outputs from this activity were the individually created lesson plans. The lesson plans produced by the members from these two groups (see Appendix N), reflected the progression of the 'Big ideas' presented on their group CoRe. The prior knowledge mentioned in the lesson plans showed that teachers had developed a clear idea of the conceptual progression in their topics. Evidence of curricular knowledge also came from the group discussions as teachers grappled with the conceptual progression of the 'Big ideas' for their specific topics.

In *Activity 10*, teachers allocated knowledge and cognitive process dimensions to the assessment tasks suggested in the CAPS for the grade-specific environmental topics they were teaching (see Activity 10, Section 4.2.1). In doing so, they were focusing on curricular knowledge at a topic-specific level. Curricular knowledge was evident when teachers' comprehension of content was sufficient to enable critical discussion of knowledge and cognitive processes that would be necessary to assess learners' understanding.

5.4 Summary

This chapter discussed the findings from the data presented in Chapter 4. The focus was to identify the environmental PCK emerging from the *Fundisa for Change Teaching Life & Living* professional development course to answer the main research question. Evidence of pedagogical reasoning and emergent PCK for aspects of each of the five PCK components was presented and discussed including how teachers' learning was affected by the amplifiers and filters operating through their context, beliefs and orientation and prior knowledge.

Chapter 6 Conclusion

6.1 Introduction

This chapter starts by presenting an overview of the study, followed by a summary of the main findings. Recommendations are then made and insights provided in the form of critical reflections and opportunities are discussed for future research.

6.2 Overview of the study

This research set out to explore and describe in the form of a qualitative case study, an iteration of a *Fundisa for Change* teacher professional development programme, in this case the *Teaching Life & Living* course given over a series of five sessions to teachers studying towards an Advanced Certificate in Education at UCT. The focus of the research was on identifying the teacher learning of environmental PCK that emerged from the course and how teachers were supported in this process. To this end, the study described the elements of a professional development programme identified as: the course; teachers; facilitators; and their contexts. Amplifiers and filters to teacher learning of PCK were also described. The study findings could be used to inform the revision of the *Fundisa for Change* courses as they are up-scaled for a national roll-out.

6.3 Main findings

6.3.1 *Fundisa for Change* course characteristics supporting the development of environmental PCK

Findings showed that the predominant characteristic of the course that supported teacher PCK development was the opportunity for collaborative learning. Teachers spent over half of the course time engaged in focussed discussion. Of importance also was the atmosphere of trust and mutual respect amongst the teachers on the course and between the teachers and facilitators. Teachers felt comfortable to share their prior knowledge and ideas and to

participate actively and collaboratively in the course activities. Collaborative learning opportunities appeared to be an amplifier for teacher PCK development.

6.3.2 Teacher PCK emerging from the *Fundisa for Change* course

Assessment knowledge

Findings showed that the teachers appeared to have improved their understanding of how formative assessment strategies such as feedback can be used in their classrooms to further their learners' cognitive development and seemed to have a more defined idea of what actions they needed to take to implement these strategies. Their understanding of how to use the revised Blooms Taxonomy to identify the cognitive demand of questions and, through the use of appropriate verbs, develop higher order thinking skills in their learners as per the CAPS directives had also been developed. Teachers did, however, express that they felt constrained in their performance of the formative assessment strategy of giving feedback, by the time allocations to topics in CAPS. Time pressure was also given as a reason for not developing assessments with questions at different cognitive levels. Thus, time pressure was seen as a filter to the use of these aspects of assessment knowledge.

Pedagogical knowledge

Pedagogical knowledge was developed at a general and subject level. It appeared that teachers developed their knowledge and understanding of the pedagogical strategies of: creating a climate of purposeful listening through the clarification of goals at the outset of an activity; supporting language and vocabulary development through discussion of word definitions; and, using content representations such as mind-mapping as a visual tool to scaffold conceptual development. When working with content representations at a topic-specific level, teachers reported that changing the content representation from one form to another had stimulated and challenged their thinking about the content. Teachers acknowledged that although they understood that different teaching methods could achieve different learning goals and motivate learners, they did not generally use a variety of pedagogical strategies in their teaching, citing reasons such as the assessment focus of the curriculum or their tendency to teach for assessment, large class size, limited time allocated to topics and lack of resources.

Content knowledge

Environmental content knowledge was predominantly co-constructed by teachers through the collaborative discussions within groups. Findings showed that learning about biodiversity centred on the inter-connectedness of species within an ecosystem and the importance of keystone species in understanding the ability of ecosystems to be resilient. Teacher learning of core environmental concepts appeared to involve a broadening of understanding as teachers discussed their definitions and gave contextualised examples of the concepts. The third aspect of environmental knowledge focused on in the course was exploring the water cycle as a system. There appeared to be a deepening of teacher's understanding as they changed the representation of the water cycle from one form to another.

Knowledge of learners

The course provided opportunities for teachers to think explicitly and share experiences of how they adapt their teaching for particular groups of learners and their characteristics such as language ability and motivation. For some topics, time spent developing understanding of terminology was seen as causing pressure on content coverage. This in turn acted as a filter to teaching strategies such as discussion and practical work.

Curricular knowledge

Findings showed that the course had provided opportunities for teachers to learn about progression of concepts across grades as well as within topics. Teachers did not appear to be very familiar with the CAPS curriculum for grades and phases that they were not teaching, and were surprised at the extent of the development and progression of environmental concepts in the *Life & Living* strand. Teachers reported that learning about the links between and progression of environmental concepts also enabled them to have a clearer understanding of what prior knowledge learners should have. Curricular knowledge was also evident when teachers' comprehension of conceptual development of content enabled them to feel more confidant to assess learners' understanding.

6.3 Recommendations

The study found that the main characteristic of the course that supported teacher PCK development was the many opportunities for collaborative learning. In this study, the teachers were already familiar with each other as the course formed part of their two-year ACT qualification. Where other groups of teachers that do not necessarily know each other are brought together for the purpose of professional development, the establishment of an atmosphere of trust and respect for differing points of view needs to be prioritised by the facilitators.

The study found that the CoRe template developed by Loughran et al (2004) appeared to surface conceptual planning of lessons although some of the questions were not completely answered or did not elicit the intended responses. My recommendation is that teachers should have the opportunity to engage with a completed CoRe template as a means of modelling the depth of thought and conceptual understanding required. The questions in the CoRe could also be developed to provide scaffolding of the information required.

The course provided opportunities for the development of the PCK component of 'knowledge of learners' through teachers sharing experiences of how they adapt their teaching for particular groups of learners. However, my recommendation is that this component could be made more meaningful by the examination of evidence of learner understanding such as workbooks, assessment responses and discussions and to identify common misconceptions.

The study found that time pressure appeared to be a filter to the use of some formative assessment strategies. My recommendation is that more opportunity be given in the course to developing these strategies so that they become more familiar, quicker and easier to do.

6.4 Critical reflections

The case study size was limited to seventeen teachers. These teachers were a diverse group in terms of age and experience. All were teaching at public schools, one of which was a special needs school, in various urban communities, ranging from established to informal, around

Cape Town. As such, the data would be limited in terms of generalisability, particularly to rural environments where the range of contextual challenges could be quite different.

This study was a case study of one implementation of the *Fundisa for Change Teaching Life & Living* course. The main resource used was the *Fundisa for Change Introductory Core Text*, which was produced to provide core foundational knowledge common to all the *Fundisa for Change* courses. Although some of the recommended activities were adapted for the *Life & Living* strand focus, some of the findings may be able to be generalised to other *Fundisa for Change* courses and not only to other *Teaching Life & Living* courses. This would, however, be dependent on the fidelity of other courses to the goals and purposes embedded in the *Introductory Core Text* resource.

Two of the tools used to assist with data generation could have been better adapted:

- The Teacher Beliefs Interview tool of Luft and Roehrig (2007), used in the Teacher Contextual Profile questionnaire, was able to provide a snapshot of teacher beliefs. However, using the questions from the tool in a questionnaire as against in an interview meant that the responses were shorter and harder to classify accurately with confidence.
- The CoRe template was developed by Loughran et al (2004) as a means of making teacher PCK explicit. In the course, it was introduced as a lesson planning tool. Although the teachers appeared to enjoy the challenge of thinking about planning through the CoRe questions, it became clear that the activity needed additional modelling and scaffolding, for the questions to be able to surface teachers' understanding of their learners thinking and how this impacts on their teaching. As they stood, the questions were too vague and open to multiple interpretations.

A different kind of problem arose with the audio-recordings. The audio-recordings of group discussions during the sessions were incredibly rich sources of data. However, they proved very time-consuming to transcribe, partly because people discussing in a group do not take turns to talk and partly because the microphones in the iPods used were so sensitive that they could pick up voices from other groups as well, despite the groups being spread out in a fairly large space.

6.5 Future research

The PCK definition that emerged from the PCK Summit, is divided into two parts: the planning for teaching and the skill involved in the act of teaching. This study focused on personal PCK as "the knowledge of, reasoning behind, and planning for teaching" (Gess-Newsome, 2015, p. 36). A focus for future research would be to extend the study to include how this personal PCK is subsequently enacted in classroom practice.

Another possibly useful avenue for future research would be to extend the study to one of multiple case studies of *Fundisa for Change* courses, thereby furthering the scope and generalisability of the research findings. This type of study could also assist in developing a clearer picture of the range and diversity of teacher learning from *Fundisa for Change* courses when the courses are taught in different contexts by different facilitators.

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Appendices

Appendix A Ethical clearance letter and consent forms

Appendix A1 Ethical clearance letter from Rhodes University

RHODES UNIVERSITY
Grahamstown • 6140 • South Africa

EDUCATION FACULTY • PO Box 94, Grahamstown, 6140
Tel: (046) 603 8385 / (046) 603 8393 • Fax: (046) 622 8028 • e-mail: d.wilmot@ru.ac.za

09 November 2015

To Whom It May Concern

Re: Proposal and Ethics approval for Susan Brundrit (15B4677)

The minutes of the EHDC meeting of 29 October 2015 reflect the following:

CLASS B RESTRICTED MATTERS

2015.10.4 ***MASTER OF EDUCATION RESEARCH PROPOSALS***

Susan Brundrit 15B4677
Topic*: A case study of emergent environmental pedagogical content knowledge in a Fundisa for Change teacher professional development course.*
Appointment of supervisor*: Ingrid Schudel*
Decision*: Approved*

This letter confirms the approval of the above proposal at a meeting of the Faculty of Education Higher Degrees' Committee on 29 October 2015.

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 truly

Prof. Mellony Graven
Chair of the EHDC, Rhodes University

Appendix A2 Ethical clearance letter from UCT

Humanities Postgraduate and Research Office
University of Cape Town
Humanities Faculty Ethics in Research Committee

Room 104, Beattie
Private Bag X3 Rondebosch 7701
Tel: +27 (0) 21 650 3718
E-mail: Robyn.Udemans@uct.ac.za

Ref. No.: HUMREC201512-01

11th December 2015

Ms Sue Brundrit
Department of Education
Rhodes University
Grahamstown
6140

Dear Ms Brundrit,

RE: Ethical Clearance for Research Project

I am pleased to inform you that ethical clearance has been granted by an Ethics Review Committee of the Faculty of Humanities for your research project entitled: 'A case study of emergent environmental pedagogical content knowledge in a Fundisa for Change teacher professional development course'.

I wish you all the best with your study.

Yours sincerely,

Associate Professor M Prinsloo
Chair, Humanities Faculty Research Ethics Committee

Appendix A3 Consent form for participants

Dear Teacher

I am a registered full time Masters in Environmental Education student at Rhodes University, Grahamstown. I am conducting research into the development of environmental pedagogical content knowledge during the biodiversity module using the Fundisa for Change teacher professional development material. These lectures are offered as part of the Advanced Certificate in Teaching Natural Sciences: Senior Phase (ACT: SP) programme at the University of Cape Town. I would like to invite you to take part in my study. Participation in my research is through choice.

My research question is:
How is the development of environmental pedagogical content knowledge (EPCK) supported and constructed in the Fundisa for Change teacher professional development course?
This question will be supported by three sub-questions:
1. What are the elements and relational processes between them in the Fundisa for Change teacher professional development system?
2. How does the Fundisa for Change course support the development of teachers' EPCK?
3. What EPCK emerges from within the Fundisa for Change course?

Please note that for the research, all items used are coded and will not be traceable or identified as coming from particular individuals. In order to protect your identity and maintain anonymity and privacy, no real names will be used in the writing up of the thesis.

Firstly, as part of the normal processes of the Fundisa for Change teacher professional development courses, participants complete a teacher profile at the start, a course evaluation at the finish and reflections on each lecture. During the course, participants work both individually and in groups on activities and produce a number of 'outputs' from these (usually on newsprint). You will also be completing an assignment and test. I would like to ask your permission to use these documents for my research.

Secondly, in addition to the above, I would like to record the proceedings. I would like to video the entire course, mostly as a record of the proceedings, but also so as to be able to write an accurate summary of the course with a focus on what I was doing during the course. I would also like to audio-record the group discussions during the activities. These recordings will be transcribed and analysed with respect to the research questions. I would like to ask your permission to use these recordings for my research.

Thirdly, I would like to give you a short questionnaire to complete during the course and also to have the opportunity to interview you after the course with respect to your thoughts and comments on aspects of the course. The interview will be limited to half an hour and will be arranged for a time and place convenient for you.

There will be no classroom visits associated with this research.

This endeavour will not harm in any way teachers that participate. Ethical issues such as confidentiality, right to privacy, dignity, and honesty will be maintained. No names will be revealed.

This consent letter, and analysis results will be kept safe and confidential. All the data and documents used during the conduct of the study will be disposed of a few years after the thesis of the researcher is finalised. Participation in this study is completely voluntary. Even if you agree at this time to participate, you are free to withdraw from the study at any time without moral obligation to the researcher, the Rhodes University or the University of Cape Town. Furthermore, as participants, you have the right to verify the data to be included in the final thesis.

If you are willing to participate, please sign in the appropriate boxes:

I consent that I am willing to participate in this study. I hereby give permission:

	Yes	No
1. For the documents that are produced as part of the Fundisa for Change course to be used in the research.		
2. For the audio- and video-recordings to be used in the research.		
3. To be interviewed and to complete a questionnaire for the research		

Signature _____

Date_____

Your positive regard on this matter will be highly appreciated.

Yours truly,
Susan Brundrit
Education Specialist (Sciences)
susan.brundrit@gmail.com
076 8160006
Should you wish to know more about the study, please feel free to contact my supervisor at:
Dr Ingrid Schudel
046-603 8389
i.schudel@ru.ac.za

Appendix A4 Consent form for facilitator

Dear Nomvuyo Mgoqi

Thankyou for the opportunity to teach and research the Fundisa for Change teacher professional development course. As you are aware, I am a registered Masters in Environmental Education student at Rhodes University in South
Africa. My research is into the development of environmental pedagogical content knowledge during professional development programmes.

My research question is:

- How is the development of environmental pedagogical content knowledge supported and constructed in the Fundisa for Change teacher professional development course?

Firstly, I would like to ask you if you agree to participate in the research.

If you agree, I would further like to ask your permission to use your real name in the writing up of the thesis.

I would also like to make audio- and video-recordings of the proceedings in which you and your voice would feature. I would like to ask your permission to use these recordings for my research.

Lastly, I would like to ask you to write a short researcher identity memo to be used as data and attached to the research in the form of an Appendix.

This consent letter, and analysis results will be kept safe and confidential. Participation in this study is completely voluntary. Even if you agree at this time to participate, you are free to withdraw from the study at any time without moral obligation to the researcher, the Rhodes University or the University of Cape Town. Furthermore, you have the right to verify the data to be included in the final thesis.

If you are willing to participate, please sign in the appropriate boxes:

I consent that I am willing to participate in this study. I hereby give permission:

	Yes	No
1. for my real name to be used.	NMgoqi	
2. for the audio- and video-recordings of my voice and images to be used in the research.	NMgoqi	
3. for my researcher identity memo to be submitted with the thesis.	NMgoqi	

Date 14 February 2016

Your positive regard on this matter will be highly appreciated.

Yours truly,
Susan Brundrit
Education Specialist (Sciences)
susan.brundrit@gmail.com
076 8160006

Appendix B Researcher identity memos

Appendix B1 Researcher and facilitator: Susan Brundrit

In this study, the researcher is also the facilitator of the teacher professional development course. The aim of this memo is to capture the aspects of the researcher's experience that are potentially relevant to the study as a means of making experiential knowledge explicit, as suggested by Maxwell (2008, p. 225) and Yin (2010).

I have chosen to mention below, the education, projects and organisations that have influenced me the most with regard to my current research interest.

Relevant qualifications

My first degree was a B. Sc. completed in 1984, majoring in Statistics and Psychology. Immediately after this I completed an HDE (Post-Graduate Primary) in 1986. In 1992, I completed a B.Ed, with Environmental Education in the Primary School as one of my subjects. In July 2008, I attended a "Habitable Planet" course run by Dr. Carl Palmer at UCT. Although not an accredited course, it provided a strong background to my understanding of climate change. An additional highlight to the course was meeting Prof. George Philander.

Relevant community experience

1991 – 1996
Environmental Education volunteer
KOMMETJIE ENVIRONMENTAL AWARENESS GROUP (KEAG)
I spent many years actively involved in KEAG, our local environmental group, working on a voluntary basis. I ran their environmental education projects, coordinating school competitions, holiday activities for school children and, for three consecutive years, designed and held "Wild Weekend Workshops" for teachers in the South Peninsula, where the focus was the integration of Environmental Education into the everyday teaching in the classroom.

2002 – date
Environmental educationalist
SOETWATER ENVIRONMENTAL EDUCATION CENTRE (SEEC)
Since its inception in 2002, I was involved in developing some of the course material for the three-day camps offered by this Centre. I initially assisted with the running of some of the educational programmes, most notably the Adopt-a-Beach programme and the Rockpool Studies programme. I currently hold a position on the Board of Trustees of SEEC.

Relevant work experience

Apart from my initial 10 years of working for Old Mutual teaching mathematics and developing and managing community computer centres at which I taught computer literacy to adults, my work has mostly consisted of projects. The following have been of particular interest to me:

Climate Change Education and Awareness Programme 2008 – 2009
The Schools Development Unit at UCT was awarded the contract to develop material and train teachers for this programme. I was involved in the preparation of resource material in

the form of activity cards, posters and resources DVD for this Programme. The teacher training took place at CTLI in Kuils River twice, each time for two weeks and catered for around 60 teachers each time.

UCT's SII (Schools Improvement Initiative):
My part in this project entails school-based support to maths teachers in the form of around three school visits per term to meet with teachers to discuss and plan teaching of topics. I was involved at Matthew Goniwe High School in Khayelitsha for 3 years and moved in 2016 to Usasazo High School, also in Khayelitsha.

ASSET (Association for Educational Transformation) project:
Contracted by the SDU at UCT, I have been running short maths workshops for the ASSET project. These are topic-specific courses, usually of one or two days (12 hours in total) duration and run at Masibambane High School in Bloekombos, Kraaifontein for teachers from all six partner schools in the project.

I like to work on these projects because they assist me in keeping things 'real' - being aware of what it is like to be a teacher at these large high schools, where you might be seeing 350 learners a week, have classes of over 50 with only 40 desks and limited to a textbook and a blackboard in terms of resources.

The Fundisa for Change Programme:

Teacher training materials:
In 2013, I was asked to write teacher training material for the Fundisa for Change Teaching Climate Change course. This was my first exposure to the Fundisa for Change programme. In 2014 I reorganised the Fundisa for Change FET Teaching Water modules and wrote the SP and IP modules also for Teaching Water.

Fundisa for Change Courses:
The following is a list of the Fundisa for Change courses I have facilitated. Common to all is the presentation of the Introductory Core Text.

- March 2015 FET Teaching Climate Change Polokwane
- April 2015 SP Teaching Climate Change Hermanus
- June/July 2015 IP Teaching Water Kimberley
- July 2015 FET Teaching Climate Change Hermanus
- Aug 2015 SP Teaching Climate Change Sishen
- Feb 2016 IP Teaching Life & Living UCT
- March 2016 FET Teaching Water Sishen
- July 2016 FET Teaching Climate Change Stellenbosch

Planning for the presentation of the Fundisa for Change courses
Past experience plays a large part in how I plan to present the Fundisa for Change courses. I now shift the focus according to the time of year and what the teachers will still be teaching, according to what phase the teachers are teaching, and according to what aspects of the activities worked well the last time. Maintaining as much relevance as possible is the main motivation for these shifts. Other factors influencing my planning are: the resources available

at the venue, the duration of the course and total contact hours the budget allows for and the time I expect to be needed for the various activities.

Implementing the course
I try as early as possible to set the tone for the course. I talk about 'us' and 'we' so that I include myself as a teacher. I refer to my own classroom experience and my observations and awareness of the constraints that they may be operating under. I try to keep my introductions to topics as short as possible, as I want to give teachers as much opportunity as I can to engage actively in discussion, rather than listen passively to what I'm saying. Another reason for this is that I try to use the activities to model teaching strategies rather than describe them, so that I can engage teachers in reflecting on their experience of them.

Biography

Early influences
I was born in the early sixties. My father was an academic from the United Kingdom working at UCT and my mother a nurse from the small Karoo town of Worcester. My first year of schooling took place in a government school in Newcastle, UK during my father's first sabbatical. The highly structured, streamed group work I experienced there contrasted starkly with the more traditional, transmission teaching style I experienced on our return to South Africa at the small private girls' school in Cape Town I attended. In my last year of primary schooling, I happened to read a magazine article about an alternative school called Summerhill run by A. S. Neill. The article showed photographs of un-uniformed and long-haired children of differing ages doing woodwork and science experiments together. I became fascinated by the idea of different schools with different teaching enabling different learning experiences and knew from that age on that I wanted to become a teacher.
My father was the first person in his family to attend a university (in fact his grandfather was the first literate person in the family). My mother's mother had also been a nurse and was the first educated woman in her family. Thus from both my parents came a high valuing of education and a high level of support through my years of schooling.
Politicised at the University of Cape Town (UCT) in the mid-eighties, I became aware of education as a political tool and after receiving my teaching qualification, was motivated to be subversive in the small way in which I felt I could – by teaching the Mathematics omitted in the 'Black' curriculum to matric learners at Langa High School, a township school in Cape Town, with the aim of enabling better chances of success in the matric exams and entrance to university. Computers had also not made their way into township schools at that time and for the next nine years I worked at St. Francis Adult Education Centre in Langa, establishing a large computer centre and focusing on computer literacy training for young adults.
During this time, I had relocated to Kommetjie, a small 'village' on the South Peninsula of Cape Town. Here I became involved in the Kommetjie Environmental Awareness Group (KEAG) and started to run 'Wild Weekend Workshops' on local environmental issues for teachers from all the South Peninsula schools. This was fuelled by the input I was receiving from the module on environmental education I elected to do as part of my B. Ed. (Honours) degree completed in 1992.

Employment
Since then, my employment has consisted of project work predominantly for the Schools Development Unit at UCT either developing teacher resources including textbooks, teaching in-service teachers or a combination of both. This type of work has afforded me the opportunity to experience diverse teaching contexts in a variety of South African schools.

The question of how best to structure and deliver in-service teacher professional development to maximise learning within the budgetary constraints of projects and the practical issues around availability of teachers, has always been a point of much debate amongst my colleagues and myself. This research has provided me with an opportunity to investigate teacher learning within a professional development context.

Teacher professional development

In teacher professional development, the awareness of the diverse contexts in which teachers teach, has taught me to never presume, but always to enquire as to the particular situation a teacher finds themself in. During my contact with teachers, I try to use inclusive language such as 'us' and 'we' to position myself as foremost a teacher. I refer to my own classroom experience and my observations and awareness of the constraints that they may be operating under. I empathise over the contextual constraints they face and acknowledge their efforts to overcome them. I validate the knowledge they bring from their teaching by giving them opportunity to share experiences with each other and the class. To this end, I try to keep my introductions to topics as short as possible, as I want to give teachers as much opportunity as I can to engage actively in discussion, rather than listen passively to what I'm saying. Another reason for this is that I try to use the activities to model teaching strategies rather than describe them, so that I can engage teachers in reflecting on their experience of them. I try to underplay the teacher-learner power relationship by treating teachers as equals, with respect and as professional individuals, focusing rather on our common goal of facilitating quality education. Inherent in these decisions is my belief that knowledge can be socially constructed and that effective learning has to be learner-centred.

Appendix B2 Facilitator: Nomvuyo Mgoqi

Early influences
My journey into teaching began in the early 1990's, in one of the secondary schools in the Eastern Cape. I taught at this school for three years with no teaching qualification because there was an extreme shortage of mathematics and science teachers. In 1994, I left the Eastern Cape and came to Cape Town to complete my B. Sc. After completion of this first degree I had to work and was appointed as a post level 1 teacher at a secondary school in Philippi, a suburb of Cape Town, as a Physical Science teacher. In my teaching experience I drew from one of my best science teacher's teaching strategies. Two years later I decided to enrol for a Higher Diploma in Education. This is where I met with the renowned professor of science education, Professor Ogunniyi. It was through the influence of this professor that I was inducted into different aspects of science education- learning styles and learning theories, different methodologies and approaches. This was an eye opener for me coming from Bantu education and my beliefs or orientations, not only in teaching sciences but of schooling in general, changed completely.

Employment
The Schools Development Unit of the School of Education in the University of Cape Town is at the forefront of fulfilling one of the roles of the university, to improve the quality of the education in the Western Cape and other South African provincial regions. The overall aim of the Unit is to develop quality education and learning in the fields of mathematics, the sciences, literacy, and life skills - through school-based work, materials development, and teacher training - within the framework of the national curriculum. I joined Schools Development Unit in 2003 as an Education Specialist (Sciences) and worked in different project, including university endorsed short courses, school-based support and formal qualifications such as the General Education and Training Band, Advanced Certificate in Education and Advanced Certificate in Teaching, development of quality teaching and learning materials, including online resources.

Environmental learning
My interest in environmental learning grew stronger when the SDU science team won a bid to develop materials for environmental content around climate change across the curriculum. The Climate Change Education and Awareness Project for Secondary Schools funded by the Department and Environment and Development Planning and involved Participatory Curriculum Development with various stake-holders, including NGO's, other Government Departments and Academic departments at UCT. A climate-change pack was designed which was a practical, flexible, integrated and cross-curricula learning tool for Grades 8 to 12. As such, teachers of any combination of learning areas can use it. Since then I included the environmental learning in the courses where applicable.

Fundisa for Change
In 2014 as SDU science team again we joined the Fundisa for Change consortium. The Fundisa for Change programme, is a partnership programme of government, parastatals, environmental organizations and teacher education institutions which aims at strengthening continuing teachers' professional development. In the Fundisa for Change programme, teacher environmental education capacity-building is achieved through working to improve the environmental content knowledge, teaching practice, and assessment practice of teachers (Fundisa for Change Programme, 2013b, p. 2). Myself and two colleagues took interest in the program and we took part in almost all the traingings and started to develop and delivered

short courses on Fundisa for Change. In 2014 joining the Fundisa for Change team of researchers, I saw the thought to strengthen the Fundisa for Change agenda, teacher capacity-building, strengthening teacher effective formative assessment implementation would be the route to persue. Adopting the definition by Egbo (2011) that capacity building "at its most basic analysis, has to do with the allocation of, and investment in resources- physical, intellectual or human especially when other intervening variables have failed within a given institutional or social context." He further argues that for capacity building to be effective, it should respond to the growth and development needs of the individual as well as those of the relevant institutions (Egbo, 2011).

My role in Continuing Teacher Professional Development and Capacity Building

How to help the teachers that I happen to work with has been my burden and my interest in formative assessment as way of raising classroom standards was influenced by reading an article "Inside the black box: Raising standards through classroom assessment" by Paul Black. It was not my first time hearing about formative assessment but the article made it clear for me that using formative assessment in a correct way could be one of the tool that could help our schools. The metaphor "Black box" he used in this article refers to the importance of what is happening in classroom and how the teachers the key drivers of that. It was for this reason I decided to first get a sense of teachers' views around formative assessment so that I can have a better understanding or an idea on how teachers could be supported. Through teacher capacity-building the work I do at the Unit strive to foster teacher self-efficacy. Friedman & Kass' (2002) definition of teacher self-efficacy as the ability to motivate and impart knowledge, values and morals to learners; ability to improvise when unforeseen classroom situations arise; ability to overcome disciplinary infractions without much effort; assertiveness toward school administration; mastery of the whereabouts of the school political and social systems, resourcefulness; involvement in the foci of influence within the organization. Working with teacher in different projects in and outside their schools, I strive to achieve this despite the challenges that we come across with. Natural Sciences teachers are expected to integrate environment and sustainability content knowledge in their teaching of Natural Sciences within a curriculum that is content referenced. CAPS expects Natural Sciences teachers to be knowledgeable about environment and sustainability content knowledge for them to be able to teach and assess it. Considering this, I took interest into exploring teachers' understanding, practices and challenges regarding formative assessment hoping that the results of this study will not only inform the planning and the teaching formative assessment but also inform the Department of Education and other teacher professional developers that are working in the field of assessment.

Appendix C Teacher contextual profile questionnaire

TEACHER CONTEXTUAL PROFILE

Name: _____

1. BACKGROUND INFORMATION ABOUT YOURSELF

1. How many years of work experience do you have?
Please round up to whole years.

☐☐ Years working as a teacher at this school.

☐☐ Years working as a teacher in total.

☐☐ Years working in other education roles (do not include years working as a teacher)

☐☐ Years working in other jobs

2. Were the following elements included in your formal education or training?
Please mark one choice in each row.

	Yes, for all subject(s) I teach	Yes, for some subject(s) I teach	No
a) Content for Natural Science at the level I teach			
b) Pedagogy of Natural Science at the level I teach			
c) Classroom practice in Natural Science at the level I teach (student teaching)			

3. During your most recent complete calendar week, how many hours did you spend on the following tasks over and above your normal classroom teaching hours?
Also include tasks that took place during weekends, evenings or other off classroom hours.
Rough estimates are sufficient. If you did not perform the task during the most recent complete calendar week, write 0 (zero).

☐☐ a) Individual planning or preparation of lessons either at school or out of school.

☐☐ b) Team work and dialogue with colleagues within this school.

☐☐ c) Marking/correcting of learners work.

☐☐ d) Interacting with learners (supervising/counselling)

☐☐ e) Participating in school management

☐☐ f) General administrative work

☐☐ g) Communication and co-operation with parents or guardians

☐☐ h) Engaging in extracurricular activities (sports/cultural)

☐☐ i) Other – list below

_____

_____

2. SETTING THE SCENE

A. YOUR TEACHING IN GENERAL

1. What are your personal beliefs on teaching and learning? Please indicate how strongly you agree or disagree with each of the following statements.
Please mark one choice in each row.

	Strongly disagree	Disagree	Agree	Strongly agree
a) My role as a teacher is to facilitate learners' own inquiry.				
b) Learners learn best by finding solutions to problems on their own.				
c) Learners should be allowed to think of solutions to practical problems themselves before the teacher shows them how they are solved.				
d) Thinking and reasoning processes are more important than specific curriculum content.				

2. How do you describe your role as a teacher?

_____

_____

_____

3. On average, how often do you do the following in this school?
Please mark one choice in each row.

	Never	Once a year or less	2 – 4 times a year	5 – 10 times a year	1-3 times a month	Once a week or more
a) Teach jointly as a team in the same class.						
b) Observe other teachers' classes and provide feedback						
c) Exchange teaching materials with colleagues						
e) Engage in discussions about the learning development of specific learners						
f) Work with other teachers in my school to ensure common standards in assessments of learner progress						
g) Attend team conferences/meetings						
h) Take part in collaborative professional learning						

4. How do you maximise learning in your classroom?

_____

_____

_____

5. In your teaching, to what extent can you do the following?
Please mark one choice in each row.

	Not at all	To some extent	Quite a bit	A lot
a) Get learners to believe they can do well in school work.				
b) Help my learners value learning.				
c) Craft good questions for my learners.				
d) Control disruptive behaviour in the classroom.				
e) Motivate learners who show low interest in school work				
f) Make my expectations about learner behaviour clear				
g) Help learners think critically				
h) Get learners to follow classroom rules				
i) Calm a learner who is disruptive or noisy				

6. How often do you use the following methods of assessing learning in your target class?
Please mark one choice in each row.

	Never or almost never	Occasionally	Frequently	In all or nearly all lessons
a) I develop and administer my own assessment				
b) I administer a standardised test.				
c) I have individual learners answer questions in front of the class.				
d) I provide written feedback on learner work in addition to a mark.				
e) I let learners evaluate their own progress.				
f) I observe learners when working on particular tasks and provide immediate feedback.				
g) I use questions to establish prior knowledge.				
h) I use rubrics to assess learning goals.				
i) I check the balance of cognitive levels of questions I ask in assessments.				
j) I keep a record of the process skills I am assessing.				

7. How do you know when your learners understand?

_____

_____

_____

8. How do you decide when to move on to a new topic in your classroom?

_____

_____

_____

B. YOUR TEACHING THIS YEAR – ABOUT YOUR LEARNERS

1. Please indicate the main sciences subjects that you are teaching this year?

Subject	**Grade level**

The following questions ask you about a **particular** class that you teach in one of the main sciences subjects you identified in question 33.
This particular class will be referred to as the target class.

2. Give the name of the subject and grade level of the target class you have chosen.

Subject	**Grade level**

3. Approximately how many learners are in your target class?
Please write a number.

☐☐

4. How would you describe the ability of learners in this target class?
Please mark one choice in each row.

	Much lower than average ability	Slightly lower than average ability	Average ability	Slightly higher than average ability	Much higher than average ability	Wide range of ability
a) Compared to other learners in the same grade **at your school**						
b) Compared to other learners in the same grade **more generally**						

5. For your target class, please estimate the broad percentage of learners who have the following characteristics.
It is acceptable to base your replies on rough estimates.
Please mark one choice in each row.

	Estimated percentage
a) Learners whose first language is different from the language of instruction	
b) Learners who have parent/guardian/sibling who can give academic support at home	
c) Learners who have access to a library	
d) Learners who have access to the internet via cellphone or computer	
e) Learners who have access to a computer	
f) Learners who have access to a television	
g) Learners who are above the average age for this grade	
h) Learners who are motivated to achieve	

6. How often do each of the following activities happen in the your target class throughout the school year?
Not all the questions in this section may apply to your situation. Please just answer as best you can.
Please mark one choice in each row.

	Never or hardly ever	In about one-quarter of lessons	In about one-half of lessons	In about three-quarters of lessons	In almost every lesson
a) I present new topics to the class (lecture-style presentation)					
b) I explicitly state learning goals					
c) I review with the learners the homework they have prepared					
d) Learners work in small groups to come up with a joint solution to a problem or task					
e) I give different work to the learners that have difficulties learning and/or to those who can advance faster					
f) I ask my learners to suggest or to help plan classroom activities or topics					
g) I ask my learners to remember every step in a procedure					
h) At the beginning of the lesson I present a short summary of the previous lesson					
i) I check my learners' exercise books					
j) Learners work on projects that require at least one week to complete					
k) I work with individual learners					
l) Learners evaluate and reflect upon their own work					
m) I check, by asking questions, whether or not the subject matter has been understood					
n) Learners work in groups based upon their abilities					
o) Learners make a product that will be used by someone else					
p) I administer a test or quiz to assess learner learning					
q) I ask my learners to write an essay in which they are expected to explain their thinking or reasoning at some length					
r) Learners work individually with the textbook or worksheets to practice newly taught subject matter					
s) Learners hold a debate and argue for a particular point of view which may not be their own					

7. For this target class, what percentage of class time is typically spent on each of the following activities?
Write a percentage for each activity. Write 0 (zero) if none.
Please ensure that responses add up to 100%.

a) ☐☐☐ % Administrative tasks (e.g. taking the register, handing out forms)

b) ☐☐☐ % Keeping order in the classroom (maintaining discipline)

c) ☐☐☐ % Actual teaching and learning

1 0 0 % Total

8. How do you decide what to teach and what not to teach within a particular topic?

_____

_____

_____

9. What types of learning activities do you see the learners benefiting from the most?

_____

_____

_____

10. How do you know when learning is occurring in your classroom?

_____

_____

_____

11. How strongly do you agree or disagree with the following statements about the learners in your target class?
Please mark one choice in each row.

	Strongly disagree	Disagree	Agree	Strongly agree
a) When the lesson begins, I have to wait quite a long time for learners to quieten down				
b) Learners in this class take care to create a pleasant learning atmosphere				
c) I lose quite a lot of time because of learners interrupting the lesson				
d) There is much noise in this classroom				

12. Are there any specific challenges you have with this group of learners?

_____

_____

_____

13. Based on your past experience, what are the areas of knowledge in this subject that learners tend to perform well in?

_____

_____

_____

14. Why do you think that learners perform well in the area mentioned above?

_____

_____

_____

15. What key environmental content and concepts in your subject are learners struggling to learn?

_____

_____

_____

16. Why do you think that learners struggle with the concepts you mentioned above? What is it about the concepts that make them difficult?

_____

_____

_____

17. What type of activities (outside of the classroom or jointly with other classes) are learners in your school involved in that support their environmental content knowledge?

_____

_____

_____

Appendix D Extract of completed lesson observation form

S2OBS Session 2 Observation
Lesson Study Tools
Form 1: Lesson Observation Form Date: **23 February 2016**
Group 1: Akhona, Mlondolozi, Lwazi, Viwe
Group 2: Thenjiwe, Phumza, Thozama, Thembani
Group 3: Fezeka, Khuthala, Buzwe, Daluxolo
Group 4: Nomsa, Lindiwe, Zuko
Absent: Mabhuti, Sonwabo

Time (Hour:Minutes) from video recording	**Describe what the mediator is doing [TM = Transcript of mediator]**	**Describe what the teachers are doing**
VT1: 0:03 **Introduction**	[See TM2: Session 2 Lines 4 – 74] Introduces the session using a Powerpoint. Talks about environmental knowledge being new knowledge and that especially with climate change, there being a lot of effort going into understanding the environment. Introduces the 'triple challenge' of teaching what we know, what we need to question and what we don't know. That knowledge is acessible to learners so teachers need to stay informed. That issues are complex but require a strong foundational knowledge. Talks about the core concepts in Life & Living and links this through the handout to the mindmapping activity of Session 1.	Teachers are in four groups. Sitting quietly and listening.
VT1: 0:15 **Hands out the table showing the mindmap summary of core concepts**	[See TM2: Session 2 Lines 77 – 122] Explains the table on the handout. Shows how core concepts are developed across the grades.	Teachers start reading the table while listening. Others just listen.
VT1: 0:20 **More introduction**	[See TM2: Session 2 Lines 125 – 183] Carries on with Powerpoint. Talks about environmental knowledge being contested. That there are climate change sceptics. Why 'global warming' has been replaced with 'climate change'. Talks about progression and quality and relates to mindmapping activity of previous session. Talks about planning activity for the following session. Then moves on to new topic of different teaching practices and how classroom constraints can impact on the type of methods used. Talks of different methods for different subjects.	Teachers listening, with some writing down notes occasionally.

Appendix E Sample transcript of group discussion

59:35

Groups discuss activity for around an hour

Akhona: Ja but they ready it's fine ooh sorry
Viwe: It's fine it's fine
Akhona: Here you go he's doing gym again so now his arms are sore doing gym again so the arms are sore just click on that again because we going to need it okay
Lwazi: (inaudible)
Akhona: Are we okay do we know what this how this works okay let's take this one first so what we supposed to do with our questioning techniques we supposed to decide in terms of knowledge what do we want our children to know do we want them to have a factual knowledge
Phumza: Yes
Akhona: Do we want them to have conceptual knowledge in other words the concept here it tells you classification, principals of generalisation, theories or models okay so that is where this fits in do we want them to know procedural knowledge so things like maths subjects okay so it's there you see the connection there but if you want them to know factual knowledge there then those are the skills we going to use these are the factual skills this was the knowledge so if I want them to know factual like how many of this and when did this and why did this then I'm going to look here and I'm going to expect them to remember facts
(inaudible)
Akhona: Exactly so now we've got to take those from Grade 7 and we've got to decide does the first one describe conditions that support now I'm going to cheat and look here
Viwe: Describe and support
Akhona: Yes so it's definitely describe I want to see where does it fit in here
Phumza: It fits on that side describe
Viwe: Does it fit on that side
Akhona: No describe is a lower order question so I'm expecting it to fit in here somewhere because metacognition would be high order
Viwe: Mm
Akhona: I'm expecting describe to fit in lower order so I'm going it's factual where am I fitting it in I want them to describe to understand to apply to analyse which one do I want them to
Viwe: No
Akhona: What's the question again describe
Lwazi: Describe conditions
Viwe: Describe conditions that support life
Akhona: Conditions that support life
Lwazi: Describe conditions
Viwe: Supporting life
Akhona: So am I going to do - am I understanding?
Lwazi: Don't you think that when they say describe conditions that support life you've already taught them about things that support life so it's just remembering recalling
Akhona: Perfect so that's where it's going to fit in
Viwe: Remember
Akhona: That first one there it's going to fit into remember and it's factual
Lwazi: It's factual
Akhona: Okay where did we get those
Viwe: At the back
Akhona: Then
Lwazi: There write here
Akhona: Must we write it in there then we look at the next one
Lwazi: (inaudible)
Akhona: Name name the different components that's the word
Phumza: (inaudible)
Akhona: Ja again it's a lower order
Lwazi: It's lower order
Viwe: Don't know what these are
Akhona: Its name ja so there's my noun it's factual here's my verb it's to remember

Appendix F Course reflection and evaluation form

COURSE EVALUATION – TEACHERS COURSES

The aim of this course evaluation is to assist the Fundisa for Change coordinator to continuously improve the programme and individual courses. The responses will be treated as confidential.

Part 1: Teacher's Profile

1.1 The school where I currently teach or most recently taught is best described as a …
Tick ONE answer

a) Rural school	
b) Township school	
c) Model C school	
d) Private school	
e) Home school	
f) Other: (Please specify)	

Part 2: Response to Course Components

Comment on each of the course components, with respect to its personal usefulness to your understanding and professional development. The course consisted of the following components:

1. Introduction including the movie "TED Ed on Biodiversity". After watching the clip, teachers individually wrote down as many facts about biodiversity as they could remember, followed by group discussion.

_____
_____
_____

Discussion on the movie as an example of active listening:

_____
_____
_____

2. Build a better world: Defining Equity, Sustainability, Resilience, Adaptation, Transformation.

_____
_____

3. Ecology in the CAPS: Mind-mapping the progression of conceptual development and identifying core concepts.

_____
_____
_____

4. Teaching practice: Exploring teaching methods for environmental learning – different categories of methods.

_____
_____
_____

5. Identifying teaching methods and their learning goal from a description of a series of lessons on a topic.

_____
_____
_____

6. Core concept: Earth is a closed, complex system of interacting rock, water, air and life. Activity was following a drop of water through the spheres of the Earth.

_____
_____
_____

7. Assessment strategies: Marking the water cycle activity using a rubric and the positive feedback strategy of formative assessment.

_____
_____
_____

8. Group planning of a topic using the "Big ideas" sheet

_____
_____
_____

9. Planning a lesson individually.

_____
_____
_____

10. Other comments

_____
_____
_____

2.1 The aspect of the course I enjoyed most was … [insert own answer]

_____
_____

2.2 The aspect of the course I least enjoyed was … [insert own answer]

_____
_____

2.3 The length of the course was …

Tick ONE answer.

a) Too long	
b) Too short	
c) Just right	

2.4 The content provided in this course was …

Tick ONE answer.

a) Very relevant to my needs as a teacher	
b) Mostly relevant to my needs	
c) Only sometimes relevant to my needs	
d) Not at all relevant to my needs	

Give a reason for your answer above:

_____

_____

2.7 The amount of information provided in the course was …

Tick ONE answer.

a) Too much information	
b) Not enough information	
c) The right amount of information	

Give a reason for your answer above:

_____

_____

2.8 The course materials were used effectively to support our learning on the course

Tick ONE answer.

a) Strongly agree	
b) Agree	
c) Disagree	
d) Strongly disagree	
e) Unsure	

2.9 The Fundisa for Change resources are:
Introductory Core Text booklet
Methods and Processes booklet
Framing Active Teaching and Learning in CAPS booklet
How would you rate the Fundisa for Change materials? (you may choose more than one option)
Tick ONE answer.

a) I have not given much attention to the materials so far	
b) The materials are generally excellent	
c) I have picked up some problems in trying to use the materials	

The most useful resource so far:

_____

The least useful resource so far:

_____

The materials could be improved by:

_____
_____

2.10 The trainer(s) on this course were very knowledgeable:
Tick ONE answer.

a) Strongly agree	
b) Agree	
c) Disagree	
d) Strongly disagree	
e) Unsure	

2.11 The trainer(s) used appropriate methods and approaches for working with us as teachers
Tick ONE answer.

a) Strongly agree	
b) Agree	
c) Disagree	
d) Strongly disagree	
e) Unsure	

2.12 The best aspect of the course facilitation was .....

_____
_____

2.13 To improve the course, the trainer(s) could give more attention to ....

_____
_____

2.14 The course assignment had two parts:
Part 1: Complete a "Big ideas sheet" as a group.
Part 2: Draw up a lesson plan individually.
You may choose more than one answer.

	Part 1	Part 2
a) Too difficult		
b) Just challenging enough		
c) Not really helpful in strengthening my learning		
d) Contributes to my further learning		

Part 3: Application

3.1 How strongly do you agree or disagree with each of the following statements?
Please mark one choice in each row.

	Strongly agree	Agree	Disagree	Strongly disagree	Unsure
a) I can clearly see how environmental learning is part of the curriculum					
b) I can relate what I have learnt in the Fundisa for Change course, to one or more of the subjects I teach					
c) I would be able to identify and explain key concepts related to environmental learning in my subject, to a colleague					
d) I would be able to teach environmental content beyond the CAPS curriculum in my subject					
e) I am able to explain the transformative nature of environmental learning to a colleague					
f) I would be able to use teaching methods to support higher order environmental learning					
g) I would be able to prepare tools for the assessment of higher order environmental learning					
h) I can explain a link between environmental learning in the classroom and whole school development					
i) I would be able to use the Fundisa for Change materials to prepare for my teaching					
j) I know where to find additional teaching resources for environmental learning					

3.2 How likely are you to apply what you have learnt, in your teaching at school?
Please tick only the statements that you feel apply to you

a) Very likely to apply it in my own teaching	
b) Very likely to apply it in my assessments	
c) Unlikely to apply it in my own teaching	
d) Unlikely to apply it in my assessments	
e) More likely to share it with a colleagues	
f) More likely to apply it in extra-murals, rather than in the classroom	
g) Unsure if I will apply what I have learnt	
h) I will not be teaching at schools anymore.	

3.3 To further help me in teaching environmental content and concepts in the classroom, I need …
Please tick only the statements that you feel apply to you

a) More teaching resource materials	
b) Better text books	
c) I have most of what I need	
d) Support from my principal	
e) Support from the Department of Basic Education	
f) Support from the other teachers at school	
g) More training on ……. (please specify)	
h) To keep in touch with a professional learning community	
i) Other: …… (please explain)	

3.4 If you were to describe the Fundisa for Change course to a relevant authority (e.g. the DBE or your principal), what words would you use?

_____
_____
_____

3.5 Any other comment you have on any aspect of the course or programme:

_____
_____
_____

How would you rate this course?

_____
_____
_____

Thank you for your input!

Appendix G Analytic Memo 1: Teacher contextual profile questionnaire

1. Teacher Belief Interview questions – written responses

Code key:

Trad	Instr	Trans	Resp	Ref
Traditional	Instructive	Transitional	Responsive	Reform-based

Code	Teacher	Data source		Responses to: How do you describe your role as a teacher?
Trans	Akhona	CPQ17	2AQ2	I am a good listener. When I teach I am consistent and fair because teenagers struggle with their emotions so it is essential to engage with them all the time.
Trad/ Instr	Buzwe	CPQ11	2AQ2	Facilitator of learning, guiding learners, motivate learners, correct misconceptions, interacting with parents, be a role model, inspire, set examples, stimulate learner's interests, counsel learners, planning and delivering proper content, change the community by instilling a positive mind set since education is power.
Instr	Daluxolo	CPQ3	2AQ2	To facilitate in the teaching and learning process. I am a counsellor and a confidante. I am a team player.
Trans	Fezeka	CPQ5	2AQ2	I am a mother, social worker and a teacher. I assist learners to be confident and be eager to learn so that they can acquire a lot.
Instr	Khuthala	CPQ7	2AQ2	It is to give the learners a little knowledge I have to add to what they already know. Guide them towards a brighter future.
Trans	Lindiwe	CPQ1	2AQ2	I am an interactive teacher, who believes that the learner should be part of the learning process throughout the lesson
Instr	Lwazi	CPQ14	2AQ2	To facilitate a learning process in a learners life. Lead and guide a learner to discover, investigate and eventually accumulate enough knowledge to take them to the next level.
Trans	Mabhuti	CPQ4	2AQ2	To develop learners cognitive thinking skills and facilitating these skills as it develop
Trans	Mlondolozi	CPQ6	2AQ2	A facilitator, a coach and a guider. Not the source of information.
Trad	Nomsa	CPQ2	2AQ2	Very important and to be a good example through leadership and attitude
Resp	Phumza	CPQ15	2AQ2	Teaching them content and allow them to find their way of explaining the subject. Group discussions so as to be able to be free with their peers
Instr	Sonwabo	CPQ12	2AQ2	As a teacher I guide learners through the academic and co-curricular activities with the sole aim of preparing them for the challenges of tomorrow.
Resp	Thembani	CPQ13	2AQ2	My major role is to define terms, show the way and learners must do the rest on their own and give feed back.
Trans	Thenjiwe	CPQ10	2AQ2	To provide knowledge and assist learners in developing critical thinking skills.
Instr	Thozama	CPQ9	2AQ2	Facilitate learning, explain, demonstrate, guide them
Trad	Viwe	CPQ8	2AQ2	I am a guardian, counsilar, father and lastly but non the least an educator. There to ensure growth and enriching development of each and every learner.
Trad	Zuko	CPQ16	2AQ2	My role as a teacher mentor learners to work according to prescribed syllabus (CPAS) and to guide them how its done and later evaluate them.

Code	Teacher	Data source		Response to: How do you maximise learning in your classroom?
Trans	Akhona	CPQ17	2AQ4	Question. Summarize.
Trad	Buzwe	CPQ11	2AQ4	Provision of conducive learning environment, motivate learners, engage learners in activities, clear instructions, acknowledging learners as individuals, preparedness and being exemplary.
Trans	Daluxolo	CPQ3	2AQ4	Bring participative activities where each child will have to participate/play a role in
Trans	Fezeka	CPQ5	2AQ4	By giving learners more time to do practical work than listening to me.
	Khuthala	CPQ7	2AQ4	-
Trans	Lindiwe	CPQ1	2AQ4	By allowing the learners to express their understanding of the topic at hand
Trans	Lwazi	CPQ14	2AQ4	By involving the children into as many activities as possible. Bringing opportunities to children to practically do things.
Trans	Mabhuti	CPQ4	2AQ4	Engage the learners in practical task.
Trad	Mlondolozi	CPQ6	2AQ4	Most of the time is spent on teaching and learning. About 27.5 hours a week.
Trans	Nomsa	CPQ2	2AQ4	Through active learning most of the time
	Phumza	CPQ15	2AQ4	Due to the number of learners in class 58 in grade 4 which 23 of them can't read and write it is frustrating and their behaviour (discipline) makes us not finish the work.
	Sonwabo	CPQ12	2AQ4	-
Resp	Thembani	CPQ13	2AQ4	My major strength is to institue and facilitate group work. Learn learn through peer interaction and they help each other in groups.
	Thenjiwe	CPQ10	2AQ4	-
Trans	Thozama	CPQ9	2AQ4	Give learners a chance to express their thoughts regarding the subject matter. Give them individual attention.
Trad	Viwe	CPQ8	2AQ4	Consolidate each and every lesson taught as frequent and much as possible.
Trad	Zuko	CPQ16	2AQ4	I organise teaching and learning support material to my outmost best and explain to the learners what to do and what is expected from them later.

Code	Teacher	Data source		Response to: How do you know when your learners understand?
Instr	Akhona	CPQ17	2AQ7	There is the 'AH-HA' response, verbally. Paraphrasing. Standardised tests.
Trans	Buzwe	CPQ11	2AQ7	Answering questions correctly on learnt concepts, asking questions that are beyond the learnt concepts (ie. learners), observing learners carrying out/doing work as per

				instruction, showing good results on assessed concepts
Trans	Daluxolo	CPQ3	2AQ7	They all participate voluntarily in activities and they do well in classwork and homework.
Instr	Fezeka	CPQ5	2AQ7	By asking them questions and give them work to do and if they do not understand they ask questions for clarity.
Instr	Khuthala	CPQ7	2AQ7	When I ask them questions and they answer or give them a test to check what they understand.
Instr	Lindiwe	CPQ1	2AQ7	When they are able to explain in their own words what have been discussed in the previous lesson.
Instr	Lwazi	CPQ14	2AQ7	I look at the feedback I get in oral and written work. As I teach I ask questions which give feedback on undertanding.
Trans	Mabhuti	CPQ4	2AQ7	When they are able to give examples other than the ones used in class.
Instr	Mlondolozi	CPQ6	2AQ7	By administering an assessment. If most of them answer correctly, then they understand.
Instr	Nomsa	CPQ2	2AQ7	When they can demonstrate concept on their own and when they can provide feedback.
Instr	Phumza	CPQ15	2AQ7	When assessing on class activities and oral work if they do not respond immediately then I could pick up that they did not understand, I redo the work.
Instr	Sonwabo	CPQ12	2AQ7	School based assessments and oral questions.
Instr	Thembani	CPQ13	2AQ7	When I give them an assessment of taught deliberations.
Instr	Thenjiwe	CPQ10	2AQ7	Through different assessment strategies.
Instr	Thozama	CPQ9	2AQ7	By their response to questions or tasks given during and at the end of the lesson
Trans	Viwe	CPQ8	2AQ7	When they are able to after a couple of lessons past a specific topic are able to verbally explain. Through frequent tests and activities
Instr	Zuko	CPQ16	2AQ7	Afte I evaluated my learners I check the majority performance level to check if the understood if not I make a resummary

Code	**Teacher**	**Data source**		**Response to: How do you decide when to move on to a new topic in your classroom?**
Resp	Akhona	CPQ17	2AQ8	CAPS document provides guideline of time frames but I will re-teach an aspect that requires more attention.
Resp	Buzwe	CPQ11	2AQ8	By assessing learners on a topic covered and if they show understanding, then a new topic can be introduce. (ie. Teaching from known to unknown in a concentric form.
Instr	Daluxolo	CPQ3	2AQ8	They wrote a revision test for every topic and we mark it as a class, and I assess how many would have got 50% a half.
Instr	Fezeka	CPQ5	2AQ8	When they understand the topic we were doing.
Instr	Khuthala	CPQ7	2AQ8	When I saw they are ready for us to move on.
Instr	Lindiwe	CPQ1	2AQ8	When the learners can do a small quizz on the topic discussed and gain at least 45 - 50%.
Instr	Lwazi	CPQ14	2AQ8	I move to a new topic when I have assessed to see understanding of the topic covered and done remedial work.
Instr	Mabhuti	CPQ4	2AQ8	If all learners are able to demonstate the outcomes of the lesson.
Instr	Mlondolozi	CPQ6	2AQ8	When learners show an understanding of the previous lesson.
Instr	Nomsa	CPQ2	2AQ8	As the curriculum moves along also once I see that most learners have grasped the concepts.
Trans	Phumza	CPQ15	2AQ8	Through their good performance in assessment and oral questioning.
Instr	Sonwabo	CPQ12	2AQ8	The CAPS curriculum is designed in a way that it is difficult to reteach a lesson because most of the time you have to teachto assess not for the learner to understand
Instr	Thembani	CPQ13	2AQ8	When the topic is exhausted. An assessment is given. If not done properly, I reteach and re-assess.
Trad	Thenjiwe	CPQ10	2AQ8	Guided by CAPS document irrespective of whether learners have understood or not
Instr	Thozama	CPQ9	2AQ8	When learners understand the topic done in class.
Instr	Viwe	CPQ8	2AQ8	As soon as I am comfortable with learners progress in assessments on topic. Sticking and keeping the CAPS and Work Scedule in mind.
Trad	Zuko	CPQ16	2AQ8	Limited choices because Caps tells you where you should be when. Therefore sometimes I left while learners don't understand by because of Time.

Code	**Teacher**	**Data source**		**Response to: How do you decide what to teach and what not to teach within a particular topic?**
Trad	Akhona	CPQ17	2BQ8	CAPS guidelines
Trans	Buzwe	CPQ11	2BQ8	Previous knowledge of the learners and the CAPS Document spells out content in a orderly way.
Trad	Daluxolo	CPQ3	2BQ8	I follow the CAPS document
Trad	Fezeka	CPQ5	2BQ8	No. I teach what is relevant according to the teaching plan
Trad	Khuthala	CPQ7	2BQ8	I never do that I teach all
Trad	Lindiwe	CPQ1	2BQ8	I work strictly according to the CAPS document as this is what the curriculum advisor wants.
Resp	Lwazi	CPQ14	2BQ8	I look at the culture of the class and what the CAPS document requires.
Trad	Mabhuti	CPQ4	2BQ8	I use Caps as a guideline.
Resp	Mlondolozi	CPQ6	2BQ8	Determined by the readiness of learners, based on their prior knowledge, age, completion of the previous lesson.
Trans	Nomsa	CPQ2	2BQ8	Depending on the assessment requirementsand also how long learners will take.
Trad	Phumza	CPQ15	2BQ8	Policy document of CAPS guide me of what to teach and not to teach.
Resp	Sonwabo	CPQ12	2BQ8	I use assumed knowledge
Trad	Thembani	CPQ13	2BQ8	I normally follow the time table to ensure that all subjects are equitably taught.
Trad	Thenjiwe	CPQ10	2BQ8	Guided by CAPS document
Trad	Thozama	CPQ9	2BQ8	I get guidance from the CAPS document

Trad	Viwe	CPQ8	2BQ8	I make use of course or subject documents, CAPS and/or my CA (Curriculum Advisor)
Instr	Zuko	CPQ16	2BQ8	I check the need of CAPS from CAPS documents and I personally add additional information to support needed information.

Code	**Teacher**	**Data source**		**Response to: What types of learning activities do you see the learners benefitting from the most?**
Trans	Akhona	CPQ17	2BQ9	Experiments; what they see + do
Resp	Buzwe	CPQ11	2BQ9	practical activities, activities that involve learners, activities that pertain to/include their experiences, hands on, activities that involve the environment (ie outdoor)
Resp	Daluxolo	CPQ3	2BQ9	group work; Individual oral answers or discussions; excursions
Trans	Fezeka	CPQ5	2BQ9	Practical activities; Pictures
Trans	Khuthala	CPQ7	2BQ9	When we do practical
Resp	Lindiwe	CPQ1	2BQ9	Group discussions and researching on their own
Trans	Lwazi	CPQ14	2BQ9	Practical activities are more popular as they participate enthusiastically. Also illustrated lessons do help.
Trans	Mabhuti	CPQ4	2BQ9	Practicals.
Trans	Mlondolozi	CPQ6	2BQ9	Hands-on activities and research; When they watch a video
Resp	Nomsa	CPQ2	2BQ9	Active learning, group work, learner centred.
Trans	Phumza	CPQ15	2BQ9	practical and group work.
Resp	Sonwabo	CPQ12	2BQ9	Learning through play; Group activities
	Thembani	CPQ13	2BQ9	The top group because they are motivated to learn already.
Resp	Thenjiwe	CPQ10	2BQ9	Group discussions, individual worksheets
Resp	Thozama	CPQ9	2BQ9	Practical tasks and experiments as well as group activities.
Resp	Viwe	CPQ8	2BQ9	Group work
Instr	Zuko	CPQ16	2BQ9	When visual aids are available and manipulative at all times. Learners learn best through observations [guided] but it needs a lot of time as prescribed.

Code	**Teacher**	**Data source**		**Response to: How do you know when learning is occuring in the classroom?**
Trans	Akhona	CPQ17	2BQ10	Engaging together by participation; Re-inforcing by questioning; tests
Resp	Buzwe	CPQ11	2BQ10	When learners are motivated to face a new challenge, when they are able to solve some of their own problems, when they can help others on certain aspects, when they appreciate others as they are and when behaiviour is changing in a positive way.
Trans	Daluxolo	CPQ3	2BQ10	When learners become too inquisitive
Trans	Fezeka	CPQ5	2BQ10	The learners concentrate and becomes excited and curious about the lesson.
Trad	Khuthala	CPQ7	2BQ10	by seeing the curiosity for the learners and by being participation of the learners
Trans	Lindiwe	CPQ1	2BQ10	When learners can explain what they have been taught in their own words
Trans	Lwazi	CPQ14	2BQ10	I know when I see the participation and the answers being given during the course of the lesson.
Trans	Mabhuti	CPQ4	2BQ10	When the learners are able to relate the topic to their daily life experiences.
Trad	Mlondolozi	CPQ6	2BQ10	When they achieve the assessment given.
Trans	Nomsa	CPQ2	2BQ10	When learners are able to explain their thinking and to give positive feedback.
Trad	Phumza	CPQ15	2BQ10	When all of them show interest in their learning.
Instr	Sonwabo	CPQ12	2BQ10	Every week I conduct weekly tests to check learners progress.
Instr	Thembani	CPQ13	2BQ10	When I get correct feed back from learners on their assessments.
Trans	Thenjiwe	CPQ10	2BQ10	Learners are actively engaged and ask questions
Instr	Thozama	CPQ9	2BQ10	I ask the questions and they respond. They also ask questions when they do not understand. They also get a chance to air their views.
Instr	Viwe	CPQ8	2BQ10	When learners answers and questions reflect desired outcomes.
Instr	Zuko	CPQ16	2BQ10	When average learners score above 50% of informal assessments.

2. Additional questions from the original teacher contextual profile questionnaire – written responses

Code key for themes:

Active	Active Learning	RES	Resources
AGE	Age of learners	MOT	Motivation
BEH	Behaviour	Prac	Practical work
CAPS	CAPS PCK	Relate	Relate to teaching
GW	Group work	Self	Self-regulated learning
KNOW L	Knowledge of learners	TbeliefL	Teacher belief about learning
LANG	Language		

Code	**Teacher**		**Data source**	**Response to: Are there any specific challenges you have with this group of learners?**
AGE	Thozama	CPQ9	2BQ12	Learners who progressed to grade 12 due to years-in-phase, not because they passed grade 11 (especially Maths and Physical Sciences).
BEH	Nomsa	CPQ2	2BQ12	Sometimes, they are very highper active.
BEH	Daluxolo	CPQ3	2BQ12	Descipline, and incompletion of tasks ie. classwork, Homework etc.
BEH	Mlondolozi	CPQ6	2BQ12	Class is overcrowded; discipline problem
BEH	Khuthala	CPQ7	2BQ12	YES they are too young and need to be called into order and they are too many 48 in class
BEH	Thembani	CPQ13	2BQ12	A few boys have developed a tendency of lying. Which makes a mill out of my work.

CAPS	Lwazi	CPQ14	2BQ12	Yes, Adaptation of the curriculum to suit the special needs children
KNOWL	Fezeka	CPQ5	2BQ12	Learners are not going good when they are assessed in theory.
LANG	Lindiwe	CPQ1	2BQ12	Some of them have difficulty reading with understanding and this tends to hamper my lessons as I like them to read the content before having the discussions.
LANG	Mabhuti	CPQ4	2BQ12	Yes learners who cannot read.
LANG	Phumza	CPQ15	2BQ12	Since they crese my grade 6 learners of 2015 who were struggling in reading and writing they always take time to be involved in a lesson.
LANG	Zuko	CPQ16	2BQ12	Most learners struggle to understand English as a medium of instruction. Most learners cant read with understanding. Most learners writing starly
MOT	Viwe	CPQ8	2BQ12	Learners seem to more and more demotivated and driven to achieve.
MOT	Thenjiwe	CPQ10	2BQ12	Failures who are not motivated
MOT	Buzwe	CPQ11	2BQ12	Yes, some learners have social issues like drugs in a family & divorce. These learners lack motivation and vision for future and tend aggressive sometimes or lose interest in schoolwork.
MOT	Akhona	CPQ17	2BQ12	We embrace special needs learners so I go at their pace but the accelerated learners do need to be kept motivated
RES	Sonwabo	CPQ12	2BQ12	Learner absenteeism; Lack of stationery and support from parents when it comes to apparatus.

Code	**Teacher**	**Data source**		**Response to: Based on your past experience, what are the areas of knowledge in this subject that learners tend to perform well in?**
Chem	Thozama	CPQ9	2BQ13	Organic chemistry, electrochemical reactions, photoelectric effect, doppler effect, acids and bases, rates of reactions and momentum.
Chem	Lwazi	CPQ14	2BQ13	Human and Plant biology, chemistry.
Gen	Daluxolo	CPQ3	2BQ13	Life Science
L&L	Viwe	CPQ8	2BQ13	Plant and Animal Cells, Body Systems
L&L	Thenjiwe	CPQ10	2BQ13	Ecology
L&L	Sonwabo	CPQ12	2BQ13	Life and Living.
M&M	Lindiwe	CPQ1	2BQ13	Matter and materials, especially the phases, mixtures, solutions
Prac	Nomsa	CPQ2	2BQ13	Practical lessons
Prac	Fezeka	CPQ5	2BQ13	Practical assessments
Prac	Mlondolozi	CPQ6	2BQ13	Experiments/ Hands-on experiences
Prac	Khuthala	CPQ7	2BQ13	Practical
Prac	Buzwe	CPQ11	2BQ13	Practicals where they are directly involved, Life and Living area maybe because they are part of the strand (ie animals in an ecosystem/biodiversity), Energy and Charge, maybe because of technology.
Prac	Thembani	CPQ13	2BQ13	Practical work.
Prac	Phumza	CPQ15	2BQ13	Practical and group work.
Prac	Zuko	CPQ16	2BQ13	Drawing; Making
Prac	Akhona	CPQ17	2BQ13	experiments; watching powerpoints
	Mabhuti	CPQ4	2BQ13	-

Code	**Teacher**	**Data source**		**Response to: Why do you think that learners perform well in the area mentioned above?**
MOT/ Active	Thozama	CPQ9	2BQ14	They seem to enjoy them. There are more experiments done on them.
MOT	Lwazi	CPQ14	2BQ14	They are more interested in the area and do well with things they have in their immediate environ
Active	Daluxolo	CPQ3	2BQ14	I think its because it is something (a subject) that directly involves them and it does not have a lot of abstract resources.
MOT	Viwe	CPQ8	2BQ14	They find it interesting; Lot of practical components.
Relate	Thenjiwe	CPQ10	2BQ14	It is concrete knowledge which learners can relate to
Relate	Sonwabo	CPQ12	2BQ14	You can link this topic or teach using real life examples or using the environment.
Prior/ Relate	Lindiwe	CPQ1	2BQ14	They have a lot of prior and personal experience about it.
Active	Nomsa	CPQ2	2BQ14	They get to see, touch, feel, smell. They are engaged.
Active	Fezeka	CPQ5	2BQ14	Because they are using their hands and they see what they are doing.
Active/ Self	Mlondolozi	CPQ6	2BQ14	Because they get involved in the lesson; and are responsible for their own learning.
Active/ Self	Khuthala	CPQ7	2BQ14	Because they are doing the project themselves step by step ad they could see the results
Relate	Buzwe	CPQ11	2BQ14	They are part of the equation eg habitats, ecosystems etc., learners are not isolated (ie

				they interact with these things. Technology also brings them into e equation; what they see every day and what they do every day.
MOT/ GW	Thembani	CPQ13	2BQ14	They enjoy it a lot because they are in most cases working in grps.
	Phumza	CPQ15	2BQ14	They get so interested and show eager to work when given practical work.
Active/ LANG	Zuko	CPQ16	2BQ14	Drawing and making are the skills that don't need most of reading with understanding.
Active/ TbeliefL	Akhona	CPQ17	2BQ14	Learners are visual learners. They watch TV and Youtube and will often relay what they have seen rather than had to memorize
	Mabhuti	CPQ4	2BQ14	-

Code	**Teacher**	**Data source**		**Response to: What key environmental content and concepts in your subject are learners struggling to learn? Why do you think that learners struggle with the concepts you mentioned above? What is it about the concepts that make them difficult?**
Abstract LANG	Khuthala	CPQ7	2BQ15 2BQ16	Theory To read with understanding but they wont & realise what they don't understand
LANG LANG	Phumza	CPQ15	2BQ15 2BQ16	When formulating essays, they are very lazy to think and use paragraphs. Learners do not want to construct sentences they like filling in questions and multiple questions. It is difficult for them to write since I said they were the lowest grade 6 of 2015 which in 2012 were in grade 3 from the Systemic Test the graph also show they had Barries of L.
LANG LANG	Zuko	CPQ16	2BQ15 2BQ16	Scientific Terms are difficult for grade level eg Photosynthesis. Replacement of english terms by science terms eg. Labels of human skeleton: Kneecap/Patella, Lower arm/Radius. It is really confusing for the beginers to replace english meanings by scientific meanings. Time allocated for NSTech is not enough to address the need of the subject.
Relate RES	Mlondolozi	CPQ6	2BQ15 2BQ16	Things they cannot relate to: Never saw, and have no idea about. Maybe they have no idea what 'something' is, because of lack of resources, exposure to it, etc.
  Abstract	Akhona	CPQ17	2BQ15 2BQ16	NS - Life and Living - Gr 7 (presently covering this learning the classification system section) Abstract
  Abstract	Lwazi	CPQ14	2BQ15 2BQ16	1. The effects of electrical pollution 2. The effects of electricity production on the environment 1. They are too abstract.
 Mathskil	Thembani	CPQ13	2BQ15 2BQ16	They don't struggle a lot in science of the environment. It is only in Maths where most find difficulties in.
  Mathskil	Thozama	CPQ9	2BQ15 2BQ16	chemical equilibrium calculations, work-energy theorem and graphs of vertical projectile motion Calculations and interpretation and drawing of graphs of vertical projectile motion.
  Relate	Buzwe	CPQ11	2BQ15 2BQ16	Planet earth and its revolutions causing day and night, formation of rocks from molten magma (ie Igneous) and sedimentary from sediments leaners don't experience some of the things eg spinning of earth on its own axis, formation of rocks etc.,
 Relate/ LANG	Daluxolo	CPQ3	2BQ15 2BQ16	Chemistry; Physics I think its because of a lot of principles which need to be read constantly with understanding and most of it is abstract knowledge
 Relate	Fezeka	CPQ5	2BQ15 2BQ16	Food chain They do not have food gardens at their homes whereby they could see how plants grow.
  Relate	Lindiwe	CPQ1	2BQ15 2BQ16	The solar system, movement of the Earth, planets and the moon, systems for looking into space and system to explore the Moon and Mars The environments the learners comes from does not lend itself to know more about these things. The classroom is the only place they ever talk about it. According to them it has no bearing on their every day life.
 Relate	Nomsa	CPQ2	2BQ15 2BQ16	That animals mate in order to reproduce. I would say it is what they are exposed to.
 Relate	Sonwabo	CPQ12	2BQ15 2BQ16	Planet Earth and beyond. The topic is difficult to present it to make the content real to learners.
 Relate	Thenjiwe	CPQ10	2BQ15 2BQ16	Negative human impact on the environment They do not relate the causes to the consequences.
	Mabhuti	CPQ4	2BQ15 2BQ16	N/A N/A
	Viwe	CPQ8	2BQ15 2BQ16	- -

Code	**Teacher**	**Data source**		**Response to: What type of activities (outside of the classroom or jointly with other classes) are learners in your school involved in that support environmental content knowledge?**
	Akhona	CPQ17	2BQ17	Recycling every week; Outdoor Club visits; Read articles and answer questions related to environmental issues.
	Buzwe	CPQ11	2BQ17	Environmental club. Collection and cycling of litter on the school premises and its

				surroundings.
	Daluxolo	CPQ3	2BQ17	On Mandela day they clean their communities
	Fezeka	CPQ5	2BQ17	Physical Education
	Khuthala	CPQ7	2BQ17	Planting trees, (Abor day)
	Lindiwe	CPQ1	2BQ17	None
	Lwazi	CPQ14	2BQ17	None.
	Mabhuti	CPQ4	2BQ17	World wetlands workshop held in the first semester.
	Mlondolozi	CPQ6	2BQ17	-
	Nomsa	CPQ2	2BQ17	Working in the garden and going on excertions to Kirstenbosh
	Phumza	CPQ15	2BQ17	Life Orientaion where they are allowed to perform Physical Education.
	Sonwabo	CPQ12	2BQ17	I am involved in Environmental projects which makes learners interested in science subjects.
	Thembani	CPQ13	2BQ17	One of the learners in my class has started a water project to collect water for drought stricken rural areas
	Thenjiwe	CPQ10	2BQ17	They are members of environmental clubs.
	Thozama	CPQ9	2BQ17	Writing standardized (common) formal tasks with the neighbouring school.
	Viwe	CPQ8	2BQ17	-
	Zuko	CPQ16	2BQ17	None/So far

3. TALIS questions – Tickbox questions

THEME: Contextual information about the teachers

Work experience
Question 1Q1

Years at current school	Years teaching at other schools	Years in other education roles	Years doing other work
3	2	0	0
5	0	0,5	0
4	1	0	1
2	6	6	1
9	2	0	0
7	4	3	2
1	10	3	10
10	2	0	10
14	0	0	2
8	6	6	2
3	14	6	1
4	14	0	3
4	16	0	2
6	15	0	0
10	18	0	0
7	26	0	0
25	10	2	0

Elements included in formal education or training
Question 1Q2

	Yes, for all subject(s) I teach	**Yes, for some subject(s) I teach**	**No**
a) Content for Natural Science at the level I teach	9	8	0
b) Pedagogy of Natural Science at the level I teach	9	7	1
c) Classroom practice in Natural Science at the level I teach (student teaching)	11	5	1

Hours spent working over and above in the classroom
Question 1Q3

Q3a	Q3b	Q3c	Q3d	Q3e	Q3f	Q3g	Q3h	Q3i
Planning	Teamwork	Marking	Supervising	Management	Admin	Parents	Extracurricular	Other
3	0	4	0	0	1	0	0	0
8	3	8	30?	5	5	1	1	0

2	1	7	2	5	1	4	18	0
3	0	3	4	1	5	1	1	0
16	8	5	8	0	6	3	3	0
10	2	10	4	15	10	4	2	0
1	3	0,5	1	0	0	1	1	0
14	6	7	7	5	7	3	5	2
2	1	3	1	5	5	1	3	0
1	0	4	1	1	4	1	0	0
3	2	7	2	3	1	2	2	0
4	1	6	2	2	2	1	2	2
4	4	2	8	8	1	1	1	0
3	1	6	40?	0	4	0,5	2	0
2	7	5	17	2	5	1	1	0
1	0	1	0	2	1	0	0	6
8	3	16	2	1	5	4	4	0

Science subjects taught
Question 2BQ1

Subject and Grade	**Number of teachers (Teachers may teach more than one subject)**
Natural Science and Technology 4	2
Natural Science and Technology 5	3
Natural Science and Technology 6	4
Natural Science 7	3
Natural Science 8	3
Natural Science 9	2
Maths 5	1
Geography 6	1
Physics 10	2
Physics 11 & 12	1
Technology 10	1
Life Science 12	1

THEME: Teachers instructional practices and beliefs

General beliefs about the nature of teaching and learning (Constructivist vs. direct transmission)
Question 2AQ1

	Strongly disagree	**Disagree**	**Agree**	**Strongly agree**
a) My role as a teacher is to facilitate learners' own inquiry.	1	2	8	5
b) Learners learn best by finding solutions to problems on their own.	0	3	7	7
c) Learners should be allowed to think of solutions to practical problems themselves before the teacher shows them how they are solved.	0	0	6	11
d) Thinking and reasoning processes are more important than specific curriculum content.	0	1	10	6
TOTAL	**1**	**6**	**31**	**29**

Learner assessment methods (formative and summative)
Question 2AQ6

	Never	**Occasionally**	**Frequently**	**Nearly all lessons**
I provide written feedback on learner work in addition to a mark	1	4	10	2
I let learners evaluate their own progress	0	8	6	3
I have individual learners answer questions in front of the class	2	6	6	3

I use rubrics to assess learning goals	1	4	9	3
I administer a standardised test	0	3	10	4
I observe learners when working on particular tasks and provide immediate feedback	0	1	12	3
I check the balance of cognitive levels of questions I ask in assessments	0	3	9	5
I develop and administer my own assessment	0	2	10	5
I keep a record of the process skills I am assessing	1	1	9	6
I use questions to establish prior knowledge	0	0	8	9

Instructional practices (Student oriented, structured, enhanced activities)
Question 2BQ6

	Never or hardly ever	**In about 1/4 of lessons**	**In about 1/2 of lessons**	**In about 3/4 of lessons**	**In almost every lesson**
TP-STRUC					
b) I explicitly state learning goals	2	2	6	2	2
h) At the beginning of the lesson I present a short summary of the previous lesson	0	2	4	1	9
i) I check my learners' exercise books	0	2	3	5	6
m) I check, by asking questions, whether or not the subject matter has been understood	0	2	1	5	8
TOTALS	**2**	**8**	**14**	**13**	**25**
TP-STUD					
d) Learners work in small groups to come up with a joint solution to a problem or task	0	4	6	2	4
e) I give different work to the learners that have difficulties learning and/or to those who can advance faster	7	2	1	3	2
f) I ask my learners to suggest or to help plan classroom activities or topics	11	1	3	0	0
n) Learners work in groups based upon their abilities	7	3	4	0	1
TOTALS	**25**	**10**	**14**	**5**	**7**
TP-ACTIV: Active teaching practices					
j) Learners work on projects that require at least one week to complete	3	4	2	6	1
o) Learners make a product that will be used by someone else	7	3	3	0	1
q) I ask my learners to write an essay in which they are expected to explain their thinking or reasoning at some length	4	2	5	2	2
s) Learners hold a debate and argue for a particular point of view which may not be their own	5	3	3	1	2
	19	**12**	**13**	**9**	**6**
Other					
a) I present new topics to the class (lecture-style presentation)	2	4	6	2	1
c) I review with the learners the homework they have prepared	0	1	2	5	7
g) I ask my learners to remember every step in a procedure	0	3	5	4	2
k) I work with individual learners	4	2	2	5	3
l) Learners evaluate and reflect upon their own work	2	3	5	3	3
p) I administer a test or quiz to assess learner learning	1	3	2	4	6
r) Learners work individually with the textbook or worksheets to practice newly taught subject matter	2	3	0	9	2

THEME: Teachers' professional practices

Co-operative behaviours among teachers – opportunities for the informal development of PCK (Exchange and coordination for teaching and professional collaboration)
Question 2AQ3

	Never	**Once a year or less**	**2 – 4 times a year**	**5 – 10 times a year**	**1-3 times a month**	**Once a week or more**
Exchange and co-ordination of teaching						
b) Observe other teachers' classes and provide feedback	2	7	6	1	0	1
c) Exchange teaching materials with colleagues	0	2	0	3	5	7
e) Engage in discussions about the learning development of specific learners	0	1	2	2	2	10
f) Work with other teachers in my school to ensure common standards in assessments of learner progress	1	0	2	0	2	12
TOTAL /68	**3**	**10**	**10**	**6**	**9**	**30**
Professional collaboration						

a) Teach jointly as a team in the same class.	11	3	1	0	1	1
g) Attend team conferences/meetings	0	0	5	3	6	3
h) Take part in collaborative professional learning	0	3	3	3	4	3
TOTAL /50	**11**	**6**	**9**	**6**	**11**	**7**

Teacher self-efficacy (Efficacy in learner engagement, efficacy in classroom management and efficacy in instruction)
Question 2AQ5

	Not at all	To some extent	Quite a bit	A lot
Efficacy in learner engagement				
a) Get learners to believe they can do well in school work.	0	0	5	12
b) Help my learners value learning.	0	1	4	12
e) Motivate learners who show low interest in school work	0	2	4	11
g) Help learners think critically	0	2	9	6
Efficacy in classroom management				
d) Control disruptive behaviour in the classroom.	0	0	5	12
f) Make my expectations about learner behaviour clear	0	0	5	12
h) Get learners to follow classroom rules	0	1	4	12
i) Calm a learner who is disruptive or noisy	0	2	5	10
Efficacy in instruction				
c) Craft good questions for my learners.	0	2	7	8

THEME: Teachers' classroom context with respect to learners

Number of learners in target class
Question 2BQ3
Five number summary of learners in target class: {14; 30,5; 39,5; 42,5; 70}

Perceived ability of target class
Question 2BQ4

	Much lower than average ability	Slightly lower than average ability	Average ability	Slightly higher than average ability	Much higher than average ability	Wide range of ability
a) Compared to other learners in the same grade **at your school**	1	3	8	4	1	0
b) Compared to other learners in the same grade **more generally**	1	4	6	3	2	1

Time (percentage) spent on admin, discipline and teaching during a lesson
Question 2BQ7

Administrative tasks	Keeping order	Actual teaching
2	1	95
1	5	94
5	5	90
4	8	88
10	5	85
10	10	80
10	10	80
5	15	80
12	8	80
10	15	75
10	20	70
30	10	60
25	15	60
20	20	60
10	30	60
10	40	50

Classroom disciplinary climate
2BQ11

	Strongly disagree	Disagree	Agree	Strongly agree
a) When the lesson begins, I have to wait quite a long time for learners to quieten down	4	7	6	0
b) Learners in this class take care to create a pleasant learning atmosphere	0	3	12	2
c) I lose quite a lot of time because of learners interrupting the lesson	3	7	6	1
d) There is much noise in this classroom	3	10	4	0

Appendix H Analytic Memo 2: Group discussion transcriptions

ACT = Activity

THEME	Code	Pg	THEME	Code	Pg
Assessment knowledge - Cognitive levels of assessment	AK Cog	183	CAPS focus on assessment	CAPS	209
Assessment knowledge - Strategy	AK Strat	186	Context	Context	210
Content knowledge	CK	190	Groupwork	GW	212
Content knowledge - Representations	CK Rep	196	Mediator Content Knowledge	MCK	212
Curricular knowledge	CurricK	197	Motivation of learners	Motivation	213
Knowledge of learners	KofL	200	Resources and class size	Res	213
Knowledge of learners - Prior knowledge	KofL Pknow	202	Teacher misconceptions	T Mis	214
Pedagogical knowledge - Teaching strategy	PK TStrat	204	Teacher beliefs	Tblf	214
			Time as an issue	Time	216

THEME: Assessment knowledge - Cognitive levels of assessment (Code: AK Cog)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	659-664	Lwazi: It is 'application' Akhona: Link? no it's 'implement'. Its 'implement', but I would have thought that because Lwazi: But its 'analysis' as well Akhona: Ja which is here Lwazi: 'Analysis'. You looking at you looking at evolution right oh sorry variation Phumza: Variation differences	Developing knowledge of the cognitive levels of assessment	10
TAT5G1	674-678	Akhona: So which one is it? I can't decide which category. Procedural? Phumza: Link … Let's put it under understanding because they need to understand Akhona: Use knowledge to demonstrate so it's creating Phumza: Hm		
TAT5G2	886-893	Sonwabo: Because 'why' is the most important question here. Can you see? People and animals they need the shade - that makes sense also. And also for shelter besides that use for shelter for other living organisms they use er plants for shelter Fezeka: For shelter Daluxolo: For shelter Sonwabo: So it's also part of meta it's cognitive also Daluxolo: Higher level Sonwabo: Ja it's higher level the child can think in abstract thinking	Cognitive levels of assessment	10
TAT5G2	187-196	Sonwabo: It's a it's a theory it's knowledge Daluxolo: But the fact is they explaining they explaining how food is made so they going to have to start explaining from the sun give energy Fezeka: Yes so the interrelationships between Mabhuti: It's procedural Daluxolo: Ja so it has to fall under here it can't fall under factual Fezeka: Mm mm Daluxolo: It can't fall under factual Mabhuti: But isn't it a scientific method that you use to explain the concept Fezeka: It's not in scientific methods	Working out cognitive levels of assessment. This is the groups second attempt for 'Explain how plants make their own food'. Nomvuyo asked them to read the article before starting.	10

THEME: Assessment knowledge - Cognitive levels of assessment (Code: AK Cog)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G2	88-98	Mabhuti: It's factual knowledge they must remember it Thembani: Explaining so that is level 2 Mabhuti: No (inaudible) what's level 2 photosynthesis is factual knowledge Fezeka: Mm Sonwabo: (inaudible) it's all about facts Mabhuti: It can also be conceptual knowledge Fezeka: Concepts Mabhuti: (inaudible) Daluxolo: It was conceptual knowledge it's under conceptual knowledge (inaudible) Mabhuti: It's factual and conceptual knowledge	Explain how plants make their own food - discussion of cognitive level	10
TAT5G2	189-198	Sonwabo: It's a it's a theory it's knowledge Daluxolo: But the fact is they explaining they explaining how food is made so they going to have to start explaining from the sun give energy Fezeka: Yes so the interrelationships between Mabhuti: It's procedural Daluxolo: Ja so it has to fall under here it can't fall under factual Fezeka: Mm mm Daluxolo: It can't fall under factual Mabhuti: But isn't it a scientific method that you use to explain the concept Fezeka: It's not in scientific methods		10
TAT5G2	236-245	Mabhuti: If you look at the categories its classification Daluxolo: Yes its classification ja so where is classification classifying it's still level 2 Sonwabo: Mm Fezeka: Level 2 understand Daluxolo: So if you come here Daluxolo: Because here they are in (inaudible) Fezeka: Its level 2 Daluxolo: It's all about relationships right when they categorising it has to do with relationships among the basic elements within the larger structure Sonwabo: So that is why I said here categorising or classifying	Discussing the assessment activity 'Classify food into the four food groups'	10
TAT5G2	668-673	Daluxolo: Nutrient this is classifying Sonwabo: Sometimes you need (inaudible) from someone Fezeka: No they are not classifying to classify is to look at the pictures and then put it (inaudible) Daluxolo: (inaudible) identifying Fezeka: They are recalling in this question here Daluxolo: Recognising they recognising they recognising	Finding cognitive levels of questions in a test brought by one of the teachers - Fezeka	10
TAT5G2	740-747	Daluxolo: Okay 4.2 What is the main function of the following nutrients? Right now they are Fezeka: They recalling are they? Daluxolo: Understanding Fezeka: Functions Mabhuti: So that's theoretical knowledge Thembani: You have to give the correct effect, so it's factual Daluxolo: Now they understanding that. They not applying but understanding and giving the correct facts. Right?	Group trying to work out cog level of a test question	10

THEME: Assessment knowledge - Cognitive levels of assessment (Code: AK Cog)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G2	816-825	Fezeka: So what sort of question is this? Are they? Thembani: Sorting out. They are sorting out here - where is it? Daluxolo: They've got to - this is theory. They have to know the theory. It's conceptual, right? Thembani: Yes it is conceptual but here they have to sort out according to what matches it Daluxolo: The child has got to know - the child has knowledge that vitamin C Thembani: Knowledge and he then must sort it out Daluxolo: Yeah Thembani: So where's our knowledge Sonwabo: Knowledge of classification and categories Daluxolo: You are saying its level 2 then?	Working out the dimensions for question on matching vitamins to their functions	10
TAT5G1	265-267	Akhona: So am I going to do – am I 'understanding'? Lwazi: Don't you think that when they say describe conditions that support life you've already taught them about things that support life so it's just 'remembering' 'recalling' Akhona: Perfect so that's where it's going to fit in Viwe: 'Remember' Akhona: That first one there it's going to fit into 'remember' and it's 'factual'	Awareness of learner prior knowledge impacting on cognitive level	10
TAT5G1	360-380	Phumza: I know understanding Akhona: Mm so it could be categorise Lwazi: Sort could also be um application Akhona: Ja I also think so Lwazi: Because you can sort and apply the knowledge that you got Akhona: We looking there sort animals so you actually Lwazi: Sort plants and animals into groups Akhona: And you physically doing it Lwazi: So you applying the knowledge Akhona: I do think so Phumza: We we are comparing yes Lwazi: (inaudible) Akhona: Yes Phumza: Don't you (inaudible) similarities Akhona: Yes Viwe: It can be application as well Akhona: I would write sorting it's comparing as well Viwe: Would you go so far as saying evaluating Lwazi: Mm no I don't think evaluating will work Akhona: On observable similarities no Lwazi: I would put it under application. Sort can also be there		10
TAT5G1	1524-1537	Grade 6 Viwe: Most of the times I find that… most of this er skills, I apply them. Because I like today I was busy trying to find out if kids can recall from term 1. Since like there's examination next week, it covers term 1 and term 2. Nomvuyo: Ok. You mean the cognitive? Grade 6 Viwe: Recalling of information but you find that they can classify and find out if they can compare. Like for example today I was teaching, I was teaching difference between mixtures and solutions and then now I was looking at the textbook. It told me that a cup of coffee is not a solution. Nomvuyo: mm-hmm Grade 6 Viwe: But if I can ask my colleagues, they'll tell me a cup of coffee is a solution. And then… and the reason why it was looking at the facts about the part… arrangement of particles. Which one can dissolve? Which one cannot dissolve in that way? So we normally use this but sometimes its unknowingly. But, the problem is when it comes to setting the examinations. Mid to level questions, lets say higher order, so we find out that we look at … we want the kids to pass. So we try to just have lower order to middle order, not catering for the higher order.	Use of questions of different cognitive demand	10

THEME: Assessment knowledge - Strategy (Code: AK Strat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	1148-1150	Phumza: And then (inaudible) give them a new assessment then they say even if we didn't give in something but at the very last day you must go back to term one's work that they did and give something you see so we will just give them their mark even if they're not there		10
TAT5G1	1514-1517	Akhona: Reflection. I thought it was was very, very interesting. Bringing together the formative and the summative, that for me spoke volumes because it made me realise that so much of what I'm testing that I thought was so hard, is actually middle order! So I'm going back tomorrow to look at my exam paper.		10
TAT5G1	1555-1563	Akhona: But Nomvuyo, I've realised though that with us teaching and with the volume as Viwe was saying, what concerns me is that I'm now having done this today I see how I'm teaching to be able to test. Nomvuyo: Mmm Akhona: And that should never have been… should never have been … that's been an eye opener for me. Is that my… I've lost … I think I've lost the point of… of the children. I'm thinking differently about it now. Because of chasing content. So, that's a worry.		10
TAT5G1	1575-1581	Nomsa: I think what I've learned is to actually really think about how I set up an assessment. But like Sonwabo said, we are using this maybe in a, in a, what was the word that you used? Sonwabo: Unconscious Nomsa: Some, yes, way. We are using this but … this is good coming and refreshing your, your, your memory or your skills is also good so when you go back to the class you can actually think about your questioning and thinking about how you're going to set up your assessment now, type of thing. So, this is … this was a good um process		10
TAT5G2	197-201	Daluxolo: But you see here when they explaining this is level what procedural (inaudible) which is the level to work explaining Fezeka: (Inaudible) Daluxolo: You see here's explaining explaining is on level 2 you see so it will be explaining when you ask a child to explain at this level		
TAT5G2	510	Fezeka: I'm using these taxonomy when we setting exams	Indicating usefulness – relevance	
TAT5G2	712-713	Mabhuti: We are looking at cognitive procedural knowledge this is what we looking at so we have to go back and see where does it fit	Sort food into the four food groups' discussion	
TAT4G2	20-21	Thembani: What is assessment? Thenjiwe: Assessment is the process of gathering and discussing information		8
TAT4G2	26-37	Thembani: What is an assessment? What are we doing when we are assessing? Lwazi: We are gathering Thembani: We are measuring the information Lwazi: Not only measuring Thenjiwe: Of knowledge Thembani: Of knowledge you have gathered information. How much it's a way of measuring information? Lwazi: It's not only not only measuring because you have to have to set set the assessment isn't it? Thembani: When you set it why do you set it for? Lwazi: You saying 'why' now but 'what' is it? Thenjiwe: What is it? What are you doing when you assess?		

THEME: Assessment knowledge - Strategy (Code: AK Strat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT4G2	78-94	Lwazi: So we talking of measuring, recording, analysis of Thenjiwe: Mm Lwazi: Of data retention in the student Thembani: And the teachers Lwazi: Okay data re okay let's say should we say um data retention or should we say um what do you say Thembani: Data retention is right Thenjiwe: What is the difference between data and information Lwazi: Understanding measuring recording analysis of understanding of information given right as well as um Thenjiwe: You mentioned (inaudible) Lwazi: Analysis of Thembani: Did you put testing here Lwazi: Method used ja it's also analysis of methods used isn't it Thenjiwe: Mm Thembani: And testing Lwazi: Measuring recording analysis		
TAT4G2	104-107	Thembani: What is assessment Thenjiwe: Mm general understanding Lindiwe: Checking what the child knows what they understood a measurement tool		
TAT4G2	145-154	Lwazi: (inaudible) Number two how has assessment changed since you were in school Thenjiwe: Lot of assessment Lindiwe: More more chances Thenjiwe: (inaudible) standards assessment forms Lwazi: It has increased in in quantity Thenjiwe: Okay and quality Thembani: Ja Lindiwe: Didn't it change like testing them on (inaudible) Lwazi: Just say it increased in quantity and quality		
TAT4G2	213-224	Lwazi: To what extent have you been prepared for using assessment to maximise learning Lindiwe: (inaudible) for assessment purposes Thembani: To what extent Thenjiwe: Not prepared Lwazi: The tech the technique of um what you call it assessment techniques okay different methods Thenjiwe: Different Lwazi: Okay different methods Thenjiwe: Use of different methods Lwazi: Use of different methods variety of variety of Thembani: Variety of tools different Thenjiwe: Of assessment techniques ne		8
TAT4G2	251-253	Thenjiwe: Okay there so many different er assessment techniques now compared to then we are using different methods of assessing that's why we said it has increased in terms of quantity		8
TAT4G2	256-259	Thembani: Yes we are we are in this er modern use of technology we are also examined for the computers and other modern things rather than um yesteryear all the work was there on the board and er a few examination papers but we now have a divergent or a divergence of apparatus which we can use to test the learners		8
TAT4G2	313-315	Thembani: To what extent have you been prepared for using assessment to maximise learning? Er we have maximised it maximised it with the use of a variety of assessment techniques.		8
TAT4G2	324-328	Akhona: It was very so-so. In the CAPS training that I did, assessment was glossed over what assessment meant very quickly the knowledge implication as to what had to happen every term, then we were supposed to (inaudible) higher order thinking skills um … Nomvuyo: And what else? Alright (inaudible) Lwazi: The assessment was just rushed through		8
TAT4G2	557-558	Lwazi: By observing he's assessing he's assessing what they doing he is gathering information		9

THEME: Assessment knowledge - Strategy (Code: AK Strat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT4G2	631-648	Thembani: In the first class you give them some work to do or on your part there was some information which the learners Lwazi: Which I gathered Thembani: Yes but you gathered it through the assessment of that class so when you go there to the other classes you are now better equipped than the previous one isn't it Thenjiwe: You use ja Thembani: So you have learned something Lwazi: I have assessed you see in a way if you have learned something you have made an assessment Thembani: Yes Thenjiwe: Mm the assessment is not for learners only its two way traffic Lwazi: It works two ways Thembani: Corrective assessment Lwazi: For my for my teaching my teaching to improve my teaching right my teaching methods Thenjiwe: To evaluate Lwazi: Yes to evaluate yes and also for the children for us to evaluate their level of understanding and where they are	Learning through discussion	9
TAT4G2	669-674	Lwazi: The teacher wrote these in large print on a chart and put it up on the wall so the teacher also assesses it's both for the teacher and for the learners isn't it because the teacher is assessing their ability to write reports isn't it Thenjiwe: Mm Lwazi: Right and then he puts it up on the wall so it's do the children are the children assessed getting an assessment here		9
TAT4G2	705-711	Lwazi: So then whatever that group gave them that group so it's only learner based there Thenjiwe: Mm mm they assessing themselves Lwazi: They assessing themselves Thenjiwe: Because of what they are presenting Lwazi: Mm the teacher is not is not there is not much input from the teacher here Thembani: Mm it's the learners Thenjiwe: Group assessment ne		9
TAT4G2	788-791	Lwazi: The teacher assessed in that discussion the teacher was assisting the children come up with because that list of points is not just the children's work because the teacher was in the discussion so he was assisting the children in assisting the children you are actually assessing where they are		
TAT4G2	842-845	Lwazi: Habitats at the end of the unit of the need a habitat the teacher asked her grade four class to write down answers to the following questions to see how they were able to apply the ideas she had hoped they had grasped so there is the questions but anyway this is this is a formal assessment	Recognises formal assessment	9
TAT4G2	974-981	Thenjiwe: What was it oh sorry the learners were learning to apply knowledge. Application of knowledge, it was the application of knowledge. Lwazi: And the teacher Sue: Ok. And the teacher? What was the teacher … Thenjiwe: Was measuring the level of understanding the learner understanding Sue: By? Thenjiwe: Asking questions Lwazi: Questioning		9
TAT4G2	1110-1121	Lindiwe: So we go through it like question one what was your answer one person did anybody have another answer okay that one and then we say okay that was the answer why is that the answer do you think just ten minutes not more than ten minutes and then I'm done and then but for me I found that that kind of consolidates um that they	Description of a formative assessment strategy	9

THEME: Assessment knowledge - Strategy (Code: AK Strat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
		understood what was happening within the notes and also how to apply the notes to the questions in the activity because sometimes like somebody just said they don't know how to get the information to the question and they'll write their own stuff some of them don't even know they are supposed to go back to the notes and actually look up although I tell them use the notes we just wrote to answer the activity but I found that using that ten minutes kind of strengthens their understanding the strong ones we always have those one's who are going to lag behind but the strong ones they do get it after a while after the third activity thing then they get what you are trying to do and they become more responsive		
TAT4G2	1075-1077	Akhona: We we also spoke about that um and we felt that fact that she (inaudible) made us think it could be formative rather than summative because I mean she set a test hoping she set a test (inaudible)		9
TAT4G2	1211-1212	Lwazi: Look here assessment of learning assessment of learning this is the teacher setting up a test and giving it to the children right	Clarifying their understanding	9
TAT4G2	1228-1237	Thembani: Ja actually we have come up with this with this understanding that assessment of learning is learner based and the assessment for learning is for the teacher these two (inaudible) the teacher uses (inaudible) to assess that's assessment for learning assessment of learning what did the child what is the learner going to be assessed on Sue: Okay so that's the sort of summative or more formal Thembani: No this summative Sue: And you are saying its teacher based because the teacher is using the assessment Thembani: Yes whatever (inaudible) research or whatever he is going to use in the (inaudible) for his assessment that's assessment for learning and what the child is going to do during that assessment that's assessment of learning	Understanding not clear	9
TAT4G2	1245-1256	Thenjiwe: The other one I'm not sure if it's of learning I the summative Lwazi: Of learning Thenjiwe: Of learning it's summative Sue: Yes Thembani: For the learner Sue: Ja Lwazi: For learning he is aiming to support the child Thembani: What you are doing as a teacher so we are right here what you are doing what instruments are you going to engage in your assessments like here Sue: Ja Thembani: You can use a a whiteboard as an assessment tool you can use er newspapers as an assessment tool	Understanding not clear	9
TAT4G2	1309-1327	Lwazi: So let's let's go to those questions which of these which of these forms of assessment do you use regularly Thenjiwe: We use this one Lindiwe: I think the formative Thenjiwe: This one to categorise learners Lwazi: Learner based Thenjiwe: That's what I was saying Lindiwe: The formative one Thenjiwe: There's no time for making evaluation (inaudible) evaluation of the formal assessment you give them the test the next day you teach something new you don't have time Lwazi: You teaching for assessment Thenjiwe: Ja you're teaching for assessment because you don't have time to evaluate so that you can improve on your methods. That's why you're having the same results, because you don't improve. Lwazi: We don't improve Thenjiwe: We are not improving because we are rushed for time Lwazi: All the time we are rushing it's the curriculum. It's content		9

THEME: Assessment knowledge - Strategy (Code: AK Strat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
		based Thenjiwe: Its content based ja Lindiwe: Not much time for consolidation		
TAT4G3	29-33	Daluxolo: They continuously have (unintelligible) to write continuously have um feedback ja when you assessing you want to have feedback (unintelligible) Sonwabo: You know nowadays you are teaching to (unintelligible) Fezeka: To get Daluxolo: To continuously get feedback		
TAT4G3	56	Daluxolo: Okay so assessment of learning is more like a test	Clarification	
TAT4G3	76-81	Sonwabo: Assessment for learning your assessment for example investigation (unintelligible) research so like assessment but at the same time they are learning from that research understand what I am saying (unintelligible) Fezeka Assessment Sonwabo: Assessment for learning it's like you are assessing (unintelligible) and give marks for (unintelligible) but at the same time you assessing them that they are learning something new	Mis understanding	
TAT4G2	664-669	Thembani: In the first class you give them some work to do or on your part there was some information which the learners Lwazi: Which I gathered Thembani: Yes but you gathered it through the assessment of that class so when you go there to the other classes you are now better equipped than the previous one isn't it		8
TAT5G1	1600-1604	Fezeka: Another advice that was given to us by the deputy. She said we must always apply these levels even in the classwork, even in you are giving a ten mark classwork you should make sure that the first 8, the first 8 are factual and then the last two are the higher order questions. So that the learners cannot be surprised when they get into the exam, they are used to these types of questions even in the classwork. If you ask them orally, you should categorise your questions, so that they can be used to them.		10

THEME: Content knowledge (Code: CK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT1G1	59-62	Viwe: I think that the topic itself - biodiversity – that's to do with the intertwined life, the diverse life on our globe, on Earth and how we survive together, so the main, the main focus is survival Akhona: Ja, and in the example of the coral reef if that being the keystone organism is under threat then the entire reef is then taken away.	Teachers content knowledge during feedback as they build their own understanding of biodiversity	1
TAT1G1	283-293	Mlondolozi: Sustainability is continuous it's continuous Akhona: Yes Mlondolozi: Sustain haha Akhona: Sure that Viwe: And also the capacity to endure Akhona: To ensure that the that the product that the matter (Laughter) Akhona: Continues forever and to endure – what (murmuring/laughter) Viwe: It's the quality of not being harmful to the environment or depleting natural resources and thereby it is the quality of not being harmful	building understanding together	2

THEME: Content knowledge (Code: CK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT1G1	261-272	Mlondolozi: Equity goes together with uh fairness with about how you treat people fairly (murmuring) Akhona: Fairness is a nice one um Viwe: First of all you might want to give the definition of equity uhm is the value of an asset Akhona: I've got it there Mlondolozi: Um is the value of asset (murmuring) Akhona: Just write your own definition of equity. Equity equals opportunity for all. Right, are you happy? Are you happy with that definition? Give an opportunity to all hey? Viwe: Jajajajaja Akhona: To all, not the select few Mlondolozi: Ja	building understanding together	2
TAT3G1	1036-1038	Akhona: Then we just put it on your flash. Okay right now we not very far. Actually we are. We nearly half way and you know what? I'm a lot clearer on some of the concepts than I was when we first started you know what I mean I said but actually it's all coming together.	Teacher learning	7
TAT3G1	1907	Akhona: I learnt something	Comment at end of class after teachers sharing lessons	
TAT3G2	686-693	Thembani: I disagree with you (inaudible) I beg to differ from what he is saying he is saying all food chains start with a producer Sonwabo: Yes Thembani: My argument is food chains start with the sun because the sun is the one which gives energy to the plant for photosynthesis to take place it has made it's food Sonwabo: No my point my point is these plants they get energy from the sun but pro food chain it starts with the producer is a plant yes we know plants get energy from the sun that's a good idea so	Start of a long debate about whether the food chain should start with the sun	7
TAT5G1	1021-1029	Viwe: And also I did the physics boiling water Phumza: Mm with the salt I also did that one Viwe: The evaporation one I also did Phumza: They were so excited when they see that salt coming out form that from the water because we don't have we don't have the lab we use the stove Akhona: Ja Phumza: We used the stove and the pot and then they could see what they were supposed to do Akhona: Sho Phumza: In in the lab	Teachers discussing practical work	

THEME: Content knowledge (Code: CK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT4G2	490-512	Thenjiwe: (Reading) What investigating investigating how best to purify dirty water by making a simple water filter I didn't get this one when I was reading it Thembani: Yes it's too long Lwazi: We can understand it as we read it together let's go Thenjiwe: But they making some water filters learners (inaudible) stones cotton wool and celery sticks what's this Thembani: Stalks pieces of say indigenous grass ne and cut it into pieces in stalks Thenjiwe: Mm so you put it on top Thembani: A stalk is a is a Thenjiwe: I want to get to the idea Thembani Thembani: Mm Thenjiwe: It says here the filter (inaudible) top half of cooldrinks bottles what is the top half Thembani: Okay Lwazi: What happens when Thembani: The filter Thenjiwe: It's the bottle Thembani: Okay so the top half what did they what did they put on the top half Thenjiwe: They put these different things choosing from gravel stones why did they put that Lwazi: Right you are looking at the process you are looking at the actual experiment lets go by these questions is there an assessment	Content knowledge	9
TAT4G3	192-217	Daluxolo: So I think they did something like this right and then they would choose which one would come there first right so maybe here a layer of what sand, a layer of gravel, a layer of topsoil, another layer of these ah different (unintelligible) what were they given gravel, stones, fine sand, celery celery stalks I don't know what that is one group (unintelligible) set up their different filters very carefully they measuring the amounts of sand, stones e-t-c to make their filters however (unintelligible) they were putting different amounts of dirt to water they had made into their filters Khuthala: Or would they supposed to use different or maybe they decide Fezeka: Same amount Daluxolo: Different amount Fezeka: Of water Daluxolo: Maybe a bottle here another bottle and in this water they only put sand right and in this bottle they only put water they only put gravel and in this bottle they maybe put (unintelligible) Fezeka: Now what they didn't put the same amount of water in there Sonwabo: So…. ja Fezeka: Meaning that Khuthala: So they had like different bottles Fezeka: Yes there's different bottles Khuthala: In each bottles there's different filters Fezeka: Same amount of filters but (unintelligible) ja same amount in the bottles but the only mistake they did they used different amounts of water in them ja so it can't be a fair test because for it to be fair the volume of water should be the same so that they can see so that is what the teacher wrote		9
TAT3G1	105 - 108	Akhona: You know what we can do as teachers? is we just ignore that. We think 'oh well, that's absurd.' Then we leave it. That's honestly what we do. Mediator: Ja Lwazi: yes that's what we do	Content acting as filter	7

THEME: Content knowledge (Code: CK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT2G3	622-630	Buzwe: Sun heats the water before (unintelligible) in in in which form Buzwe: The water can be in either form liquid or solid (unintelligible) solids or liquids Buzwe: Okay Fezeka: The sun heats the water Buzwe: But but it can this thing on the (unintelligible) now basing basing on the diagram it it must be liquid water Khuthala: The sun changes the sun can heat the clouds the sun rays can heat the water from the river Daluxolo: Yeah there's no (unintelligible) there Khuthala: There's no (unintelligible) okay there's always clouds and there's always sun to heat the	Working out the water cycle	6
TAT2G3	646-655	Buzwe: There's water up there there's water up there Khuthala: Even the sun can even heat the water vapour from the air Fezeka: And then Buzwe: Right the sun heats the water is it Daluxolo: Eh eh Buzwe: And the water changes into what Khuthala: Water vapour Buzwe: Yes water vapour		6
TAT2G3	665-666	Buzwe: In the water bodies also on plants because remember plants are going to lose water through through transpiration as well		6
TAT2G3	719-733	Daluxolo: The wind when the clouds are full the clouds are going to be moved by the wind the clouds are moved Fezeka: The wind blows the clouds Buzwe: To another area Fezeka: Mm mm Buzwe: Okay Daluxolo: (unintelligible) right now Daluxolo: This water vapour it's warm right Buzwe: Mm hm Daluxolo: And then it has to meet up with cold air Buzwe: Cold air Fezeka: Mm Daluxolo: The warm water vapour Buzwe: Warm water vapour meets Daluxolo: Meets with cold air	One teacher explains to the others - goes on for some time explaining whole cycle to the others PEER LEARNING	6
TAT2G3	1021	Buzwe: In actual fact it can move from from any sphere into other spheres	Understanding water flow through spheres	6
TAT2G3	1040-1043	Buzwe: But that is only for plants. What about animals? Daluxolo: But we also drink water don't we drink water from boreholes. Buzwe: Can we say its absorption by (unintelligible) No we drink it we drink it Daluxolo: From rain		6
TAT2G3	1181-1186	Daluxolo: Yes but this one the soil also gives off water to the hydrosphere you know when water is moving from underground. Alright but what is it now Buzwe: W w w when what Daluxolo: Water sinks in the soil and then remember it moves underground let's say it's on a slope Buzwe: Like sinking Daluxolo: Ja it's seeping through		6
TAT2G3	1273-1275	Daluxolo: Oh okay. So you can also talk about deforestation right because it affects that Mediator: Ja ja so when we we open a tap where does that water come from Daluxolo: Here here we saying fresh water wastage of fresh water		6

THEME: Content knowledge (Code: CK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT2G3	1295-1301	Buzwe: For all the human ja can you also see even from here the atmosphere atmosphere and water because the moment we use water on machines the machines will run and in turn they emit those gases that make air pollution Daluxolo: We pollute the atmosphere meaning we get like acid rain and then that acid rain can destroy plants as well Buzwe: Just the water in the soil and from irrigation because we need the water from the machines but these machines have got another impact on the atmosphere		6
TAT2G4	451-457	Lindiwe: Okay. Water cycle. Where does it all start? With precipitation Zuko: Mm mm doesn't it start with evaporation? Lindiwe: It starts with the water. The water in the sea, the sun shining down (unintelligible) Zuko: Ja Lindiwe: Then up goes the water and it becomes Zuko: So evaporation the first, yes? So everybody decided? No heating and then sun Lindiwe: But first the sun heats up the water and it evaporates	Thinking about the water cycle	6
TAT2G4	488-494	Lindiwe: It has now evaporated. So now what happens? Clouds are forming Zuko: The er water the air around becomes warm. It rises up Lindiwe: Mm hm now. That we said already - it evaporated Zuko: It rises up rises up Nomsa: So the air rises Zuko: Ja, warm air rises always. Evaporation Nomsa: Becomes warm and rises	Thinking about the water cycle	6
TAT2G4	506-510	Lindiwe: It isn't the lithosphere? Zuko: Lithosphere Lindiwe: Isn't the lithosphere the earth? Zuko: Hm Lindiwe: What is the hydrosphere?	Working out the spheres	6
TAT2G4	543-545	Lindiwe: And then after the clouds forming we get the precipitation when it starts Zuko: Where's condensation? Precipitation starts because of condensation Lindiwe: Oh ja ja		6
TAT2G4	560-565	Lindiwe: So there it is in a liquid form ne? Zuko: In the gasses form this one. And then the condensation start and then precipitation occurs and that Lindiwe: Is that when the (unintelligible) is taken up ne Zuko: Mm this one is a gaseous state and at this stage it's a it becomes a a liquid state and this one is a liquid state liquid state ja Lindiwe: (unintelligible) so when it snows it becomes solid?		
TAT2G4	614-619	Zuko: Mm the water process er okay land forms land forms er develop as a result of the nature of the rivers because they are sometimes there are erosions and so they start to wash out some sand and then create land forms Nomsa: Land Zuko: Forms starts or rather begins. Begins as a result, result of the nature, of the nature, of precipitation, precipitation		6
TAT2G4	701-703	Zuko: The air condenses towards the ground because sometimes if it was hot during the day and then it becomes cold at night you find dew in the morning. So that air condenses to this (inaudible) subject to correction. Take an arrow here and then up here. That's condensation.	Translating the water cycle into the spheres diagram	6
TAT2G4	712-713	Lindiwe: And all of those from there to there you know it also goes from the pedosphere to the biosphere because the plants get their water out of the soil		6

THEME: Content knowledge (Code: CK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT2G3	971-982	Daluxolo: We say rain - the atmosphere - this is where water is leaving one sphere one of the spheres Buzwe: Ja Daluxolo: And going to the other Buzwe: But then that what is that? Like for instance the process it the operation Daluxolo: Say? Buzwe: Evaporation is the process but what about to flow from gas back to water Daluxolo: From gas to liquid Buzwe: To to to liquid Daluxolo: That's condensation Buzwe: Condensation Daluxolo: Mm hm Buzwe: So you can talk about condensing from there to there and you could specify evaporation	Building common understanding	6
TAT2G3	1203-1207	Khuthala: It's pollution it's pollution in water in the hydrosphere Buzwe: What what is it Khuthala: Human impact on water Daluxolo: Oh the human impacts on water draw another circle no no just Buzwe: Human impact on water we can pollute water	Human impact	6
TAT2G3	1246-1256	Daluxolo: Er deforestation hey they want human impacts on all the spheres Buzwe: Is it only water I'm not sure but I think so Daluxolo: Okay let's ask then here also we can have Buzwe: Mm Daluxolo: Here Buzwe: Mm Daluxolo: Wastage wastage of fresh water we've got a crisis right now in South Africa Fezeka: Mm Daluxolo: We need fresh water it's running out so we can say Buzwe: Wastage Daluxolo: Wastage of fresh water	Human impact	6
TAT1G1	29-47	**Viwe:** umm ok so I as I read biodiversity has three main categories – ecodiversity, species diversity, genetic biodiversity and then just to summarise it um what I got out of this, is Earth is a big intertwined web of biotic and abiotic components focused on survival in unity as parts of these segments of the web disappear due to destructive events, either natural or unnatural - the strength of the system decomposes. So …um… Earth on a whole is … seen as a, a, a body with different parts and having different functions … in my opinion. **Akhona:** And then the example they gave was the Amazon um being the largest example of biodiversity and specifically the trees in the Amazon – just how they provide food and homes for animals and then the insects like the seeds um and this in turns strengthens the whole process of of biodiversity. 24:21 **Mabhuti:** What I see is the Amazon is an example of life process. So if you remove a single species the ecosystem falls apart but if you have other ecosystems where all the species are dependent on each other so if you remove one, just a single … **Akhona:** Like coral **Mabhuti:** Coral is an example. The whole ecosystem collapses so that can be a **Mlondolozi:** Not to mention the interdependence **Akhona:** Yes **Mlondolozi:** And they are depending on each other, depending on the food. And also humans out of the environment. That's what I remember.	Developing understanding of biodiversity concepts	1

THEME: Content knowledge (Code: CK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT1G1	302-308	Akhona: What's resilience? Mlondolozi: (unintelligible) overcoming (unintelligible) Akhona: Yes resilience is to Viwe: The power or ability to return to the original form Akhona: Return or to stand fast. Overcome obstacles Mlondolozi: Or challenges Akhona: Or challenges, yes.	Discussion of definitions	2
TAT2G4	840-844	Zuko: And also for transporting purposes, water transport Nomsa: Even electricity Zuko: Ja electricity because it generates electricity Nomsa: Water is actually a big deal ne Lindiwe: We have so little of it if you think how much they use just in the mines ne in the mines	Human use of water	6

THEME: Content knowledge - Representations (Code: CK Rep)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT2G3	875-878	Mediator: And I'm very interested that two of the four groups have found it a little bit difficult to actually do sentences without some kind of a flow chart or diagram attached okay I think we so used to seeing the water cycle as a visual that actually writing sentences about it was a little bit I wouldn't say that it was challenging but it required a bit of thought	Observation that teachers were finding it hard to change the content representation – translation	6
TAT5G1	1487-1488	Phumza: Recording information recording data from (inaudible) including drawings descriptions tables and graphs (inaudible) is that not a drawing when they are labelling the flower	Content representations	10
TAT4G2	1045-1046	Akhona: A the first one the learners used it in the form of a labelled drawing but actually it was the teacher that got the prior knowledge		9
TAT4G2	607-615	Lwazi: Both of them used it so that one is gone done seen processes to purify water at the end of the topic their topic the teacher held a discussion with the whole class about how to purify water so that others could understand it the learners the learners ended up with a list of points to remind them what had been done what had been found how it could be explained the teacher wrote these is large in large print on a chart and put it up on the wall while the learners wrote a report they were reminded to pay attention to the points listed when they presented their reports to each other they used the list to make constructive comments about how they how the reports could be improved constructive comments okay so was it an assessment yes		9
TAT4G2	658-660	Thenjiwe: The second one the teacher wrote (reading) these is large print on a chart and put it up on the wall while the learners wrote a report they were reminded to pay attention to the points listed when they presented		9
TAT4G2	669-671	Lwazi: The teacher wrote these in large print on a chart and put it up on the wall so the teacher also assesses it's both for the teacher and for the learners isn't it because the teacher is assessing their ability to write reports isn't it		9
TAT4G2	697-699	Thenjiwe: No it's the learner (inaudible) he just wrote this in large print it's the points that were given by the learners and then he made the large print on the chart and then he put it on the wall the points that were given by the learners isn't that so		9
TAT4G2	686-690	Thembani: It's like it's like you you've (inaudible) Thenjiwe: It's additional learning from them I thought it was the learners are learning something and the teacher is explaining something Lwazi: Yes the teacher learns how the teacher is okay the teacher is looking at the children right as they give their their reports		9

THEME: Content knowledge - Representations (Code: CK Rep)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT4G3	366-368	Daluxolo: (Reading softly) (unintelligible) …the teacher wrote these (unintelligible) … drawings with their reports they were reminded to pay attention to the (unintelligible) presented their reports to each other they used this to make constructive comments about		
TAT2G4	438-443	Lindiwe: What are you doing Nomsa: Here I'm going to make this into (unintelligible) Zuko: We are drawing the water cycle? Nomsa: No something different Zuko: Okay okay go for it no go for it Mediator: Sentences I'm asking for sentences okay	Trying to represent the water cycle but not as a cycle	6
TAT3G1	709-720	Mlondolozi: There's a lot of confusion (laughs) How would you ascertain learner understanding? Phumza: If they don't respond and then they just look at you when you are talking, because of what we said –cultural limitation Mlondolozi: I think that the best the best thing you can use in this case would be the use of, use of pictures. I think pictures explain more when it comes to variation. Right the use of pictures how would you ascertain Akhona: Look here, this thing here um activity Phumza: Mm Akhona: Do you have a dog or have you seen some dogs? Question: what kingdom, what phylum, what class er common characteristics, so questioning hey? Phumza: So prior knowledge, because we did this Mlondolozi: Yes yes yes investigate prior knowledge	Also prior knowledge/ Know your learners/ content representation	
TAT3G2	81-82	Sonwabo:Some of the eco-systems are taught in abstract Thembani: Some eco-systems are taught in abstract so they learners cannot understand	Abstract = difficult	7
TAT3G2	901-909	Sonwabo: But today (inaudible) guys er particles is the smallest thing to them like what did (inaudible) say about the difference between liquid solid and all that then you can spend the whole day explaining about this this space and space and all but today we don't make sense So what I did now I've got like a video about particles of solid of liquid and all that they now remember this particle they that video those more those particles moving around. Now it makes sense to them to see what's really going on but otherwise the abstract to them don't make sense and what has it got to do with the real world and to thems like what does (inaudible) you know that's (inaudible) science so I try to incorporate everyday life with science	Video as resource	7

THEME: Curricular knowledge (Code: CurricK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	1645-1650	Thembani: I think the teaching of science is different to the teaching of history to so what you are doing is you have to try by all means to explain to them something in the hand because if you come to Grade 6 and you've skipped that malleability aspect ,then in grade 6 we don't have that. So, which means that child has lost that aspect until maybe he's in grade 8 or 9. So, a therefore you must make sure that you ask them in Grade 6 a lesson must not go, must not go just to play		10
TAT4G2	39-48	Lwazi: Both of them used it so that one is gone done seen processes to purify water at the end of the topic their topic the teacher held a discussion with the whole class about how to purify water so that others could understand it the learners the learners ended up with a list of points to remind them what had been done what had been found how it could be explained the teacher wrote these is large in large print on a chart and put it up on the wall while the learners wrote a report they were reminded to pay attention to the points listed when they presented their reports to each other they used the list to make constructive comments about how they how the reports could be improved constructive comments okay so was it an assessment yes		

THEME: Curricular knowledge (Code: CurricK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT4G2	400-403	Lwazi: The children have to (inaudible) thing Thenjiwe: (inaudible) to plant a big one here before beginning however she decided to find out what the learners knew and thought about the concept of biosphere and the requirements for sustaining life		
TAT4G2	949-963	Thembani: From the unit which had been covered Lwazi: At the end of the unit the need for habitat the teachers question the need for how they were able to apply ideas to show how they had grasped Thembani: Is it from the book or from the from the curriculum Lwazi: We are looking at it from CAPS you don't do you get information from it's more from the National Curriculum because you assess based on the requirements of the curriculum the book assists you Thembani: All the books which are caps align are taking it from the CAPS document Thenjiwe: From the CAPS curriculum Lwazi: So it's it's Thenjiwe: So this information on how to answer this one they are not going to look at the curriculum they will look at the book to get some information		
TAT4G2	1159-1163	Man: Not what you want the kids to understand so whether the kids understand or not is not effective because they want you to cover those concepts so most of the time you find you are teaching to assess and not the other way around so the kids the kids that's why the kids are struggling to relate whatever you are teaching the class with real life		
TAT4G3	380-383	Daluxolo: At the end of their topic right so this is at the end of their topic so the teacher is now giving up it's like they are they are re-capping so yes there is what information was gathered the information that was gathered was from the whole topic that they've done		
TAT1G1	850-855	Viwe: Isn't species a part of grade 7? Akhona: Ja it is Viwe: Species is a part of grade 6 as well isn't it? Akhona: Oh variation is a part of grade 7 you right sorry. Species, no it's variation Mabhuti: And then species Akhona: And then species there okay and then so that would be grade 6? Grade5?	Doing the mindmap – tracking conceptual progression across grades	3
TAT1G1	990-995	Mabhuti: Invertebrates can also come in here also Akhona: Are you sure Viwe: Yes in grade 5 they do vertebrates Akhona: Because we do vertebrates in grade 7 Mabhuti: I know that. In grade 4 they do herbivores, carnivores, omnivores Akhona: You see now, this is all grade 7		3
TAT1G1	1135-1142	Viwe: Oh that's the scientific method they do it in grade 8 Akhona: Under life and living Mabhuti: Yes Viwe: It's part of the science (unintelligible) but do they do it in grade 7 or 6 Akhona: 7 as well but only in physics Mabhuti: We did the test for starch Akhona: Okay ja I wish my grade 6's did all this, they wouldn't be so clueless Mabhuti: In Grade 7		3
TAT1G1	1188-1194	Akhona: What do we have here? Course (unintelligible) thank you. Right air, sunlight, relationship I'm horrified. The whole of grade 7 is sitting in these earlier grades. Why don't these children know anything? Excuse me? Mediator: Okay so that does mean that those kids who have been paying attention might be a little bored? Akhona: Completely. I walked away now and thought you know what, I need to get through this stuff in a week, not in three weeks		3

THEME: Curricular knowledge (Code: CurricK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
		(unintelligible)		
TAT3G1	338-346	Mlondolozi: Ja reproduction is important ja Akhona: Why? Phumza: In order to have a different species there must be must be reproduction Mlondolozi: Sustainability Lwazi: Ja the continuing Akhona: But doesn't this come up with inheritance? No Mlondolozi: The continuation of the species depends on reproduction Akhona: We've got to use reproduction because look that's what creates differences in inheritance hey Lwazi: Because then the inherited characteristics form generation. different generations	Location of concepts	
TAT3G1	1041-1053	Akhona: What do we know about learner thinking? Mlondolozi: We talking about reproduction, reproducing of the same species Lwazi: Mmm Phumza: Learner thinking Mlondolozi: Mmm Akhona: I think we need to say there is prior knowledge. What do we know about learner thinking? They have the prior knowledge with the angiosperm. Remember, we had to do Mlondolozi: Yes, yes. They did the whole of the plant thing. They did the whole Akhona: Yes Mlondolozi: So there is prior Akhona: Angiosperm and from that human reproduction. In the previous, prior knowledge in the previous chapter of Lwazi: reproduction	Curriculum knowledge/ Prior knowledge	7
TAT3G1	1287-1296	Akhona: A limitation is having prior knowledge on genetics. Oh, I hadn't got that! Lwazi and Mlondolozi: Mmm Akhona: Prior knowledge of genetics. I actually am aghast here that I didn't connect genetics to all of this Mlondolozi: Ja myself Akhona: I wasn't thinking genetics Phumza: Prior knowledge of Akhona: Genetics Mlondolozi: Anyways Lwazi: Sharp boetie, sharp	AHA moment as concept understood	
TAT3G1	1483	Phumza: Sho this is what CAPS wants us to do?	AHA moment re CAPS	
TAT3G1	1633-1645	Akhona: What we don't want them to know? That some traits we inherit Phumza: Some Akhona: Some traits Phumza: Traits Akhona: Some traits we inherit um such as skin colour or height um children don't like … you know my son doesn't like his big ears cos his father's got big ears Mlondolozi: Oh yes Akhona: That's what they don't like Lwazi: I don't think we will see anything here Mlondolozi: (Unintelligible) unattractive Akhona: Some traits Phumza: Mm Akhona: Are traumatic for children	Lack curric sal ie. the teachers are thinking of general things not whats coming up in CAPS	

THEME: Curricular knowledge (Code: CurricK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT3G1	1756-1764	Phumza: No man I was asking the real, the real thing that we are going to do with learners for this term for the practical what was it Mlondolozi: Practical task Phumza: Mm what did you do? Mlondolozi: I did um I did an investigation into the growth of a bean stalk within a Phumza: But they did that, they did that in grade 4 Mlondolozi: Yes but now they are looking at with sunlight, without sunlight without, without water Akhona: I did the snail Phumza: How did you do the snail?	Teacher shares lesson ideas showing understanding of conceptual progression and teaching strategies	
TAT3G1	1519-1524	Mlondolozi: When do they Phumza: This idea this idea of inheritance Mlondolozi: When do they start to know about the chromosome? Is it grade … Akhona: Grade 7 Lwazi: Grade 7, so it's the right time Mlondolozi: They learn that its 23 chromosomes? Lwazi: 23 chromosomes	Teachers learning from each other	
TAT3G2	37-42	Sonwabo: Why is it important for learners to know this? Thembani: Learners to be able to know to use differentiate they must be able to classify to classify living things and non-living things putting them into categories they must be able to identify living things and non-living things to separate living things from non-living things Sonwabo:What about if we say um Thembani: They should be able to identify	Reason doesn't relate to concept development	7
TAT3G2	60-62	Thembani: We don't want them to know that some living things have skeletons and some do not have skeletons Sonwabo: They did that in Grade 4	Lack of curric sal	7
TAT2G4	196-207	Lindiwe: To link Natural Science with Geography Zuko: Just write NS with Geo Nomsa: With Geography Zuko: Geo Nomsa: Geo Zuko: And the and the symbols are not related to the art mm the symbols because the map can't Lindiwe: Mm that's that's all Geography that's Zuko: (unintelligible) Okay Lindiwe: And then in (unintelligible) Zuko: Integration ja Lindiwe: (unintelligible) and then she's going to take them on a field trip Zuko: Just write integration of subjects integration of subjects okay	Curricular saliency across subjects	5

THEME: Knowledge of learners (Code: KofL)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT1G1	508-515	Akhona: Resilience the definition is how the ability to overcome Viwe: It's a difficult job for teachers because it boils down to motivation Akhona: Motivation to do what? Viwe: Motivation to motivation to overcome a failure, fail of a test, fail of an assignment or whatever the case may be as teacher to (unintelligible) resilience as a part of everyday teaching and learning Mlondolozi: To overcome failure Akhona: Failure and disappointments Mlondolozi: Disappointments	Discussion of definitions	2

THEME: Knowledge of learners (Code: KofL)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT1G1	594-600	Mlondolozi: Cater resources for learners with with with learning barriers you know in terms of learning Mediator: Ja Akhona: So your tests would be different Mediator: Ja so you adapting ja according to the (unintelligible) in the classroom Mlondolozi: For special needs Mediator: To be inclusive? Mlondolozi: Ja	Discussion of definitions	2
TAT3G1	111-114	Akhona: I I have big issue with asking them personal information from home because we have so many children that are fostered etc etc Mlondolozi: Exactly Lwazi: Exactly	Know your learners – learner context acting as filter	
TAT3G2	373-384	Thembani: The concerns for teaching this food web Sonwabo: Abstract Thembani: Read what I wrote Sonwabo: Abstract Thembani: If you don't have tangible things Sonwabo: But if I say in a whole eco-system in (inaudible) Thembani: Ah (inaudible) Sonwabo: The feeding relationship relationships between plants and animals are more complex are much complex than a simple Thembani: Food chain Sonwabo: Food chain Thembani: Some learners my not understand that	What is difficult to teach	7
TAT3G2	622-628	Sonwabo: Learners struggled to distinguish between primary, secondary and tertiary consumers Thembani: Eh Sonwabo: It was a struggle to distinguish between primary, secondary and tertiary consumers because some some some of the things they intertwined so the kids just put them together Thembani: Okay	What is difficult to teach	7
TAT3G1	563-657	Cultural issues, diversity, religious factors and shy to talk about 'reproduction', taboo topic, preconceived ideas		
TAT3G1	626-637	The learner thinks that this is a taboo topic. You can't touch this topic		
TAT3G1	824-828	Phumza: Okay and now why is it important for learners to know this about all living organisms reproduce sexually Akhona: Okay. Here, to dispel the myths of cultures, cultures? Phumza: Mm? Akhona: And to recognise that they are unique.	Importance of concept	
TAT3G1	871-872	Phumza: What difficulties or limitations are connected with teaching this idea? Akhona: That some children are pregnant in the class	Contextual	
TAT3G2	242-249	Sonwabo: The learners which influence them many learners do not differentiate between the seven life processes do you know that many students do not Thembani: What what do you mean? Sonwabo: Use the seven life processes Thembani: For animals Sonwabo: To differentiate Thembani: Mm to differentiate Sonwabo: Living and non-living		7
TAT3G1	1110-1116	Akhona: Or we can say um what the children bring to the discussion you know. What the learners bring to the discussion Mlondolozi: What the learners Akhona: Bring to the discussion. That influences our teaching Mlondolozi: Mm Akhona: Ja what teaching methods would you use and why for this idea? Mlondolozi: I think what learners bring to the discussion – this includes even attitudes as well Five E's, verbal questionning and listening for student questions	Learner outcomes acting as filter	7

THEME: Knowledge of learners (Code: KofL)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT3G1	144-151	Lwazi: That's why I mean, I mean traditionally um traditionally, well we were brought up to believe that scientifically you were supposed to look like your father Phumza: Your father, your parents Lwazi: The first question that is asked when a baby is born in an African culture is who does the child look like Mediator: Absolutely. Yes no in any … I think in all cultures Lwazi: In all cultures Phumza: In all the cultures	Know your learners – misconception from cultural understanding making difficult to teach	
TAT3G2	251-257	Sonwabo: Look at the percents now look at an example take a car it moves because there's movement in living things. A car moves Thembani: It's a non-living Sonwabo: It's a non-living. Thembani: People move but they are living Sonwabo: So a plant cannot move Thembani: A plant moves when it grows it moves	Learner misconceptions around living and non-living	7
TAT5G1	1615-1625	Daluxolo: Er, just want to … like on the explaining. Which is like ask me a question like explain, or describe. Like with most of them you find that there is a language barrier that they start explaining ohhh, and they start writing something else, totally. So what I'm try to even do is identify your main facts and just then write it in point form. So, I don't know, is that good? Is it bad? Because when they start explaining, I tell you its … Nomvuyo: You have to give them a sort of a framework even if they sort of feel in … its good because of that language barrier. Its good then if they write in full sentences. You sort of teach them and give them… Daluxolo: Ja, during classwork I do that, but then, um, when it comes to examinations now I try to limit them from writing oh, because they really go way, way, wayward, out of the, they fail to get the whole idea	Language issue impacting on teacher's assessment strategy	10
TAT5G1	1621-1636	Zuko: What I've learnt is that er, the most challenging that we are having, especially in sciences, is the time allocated for science. Because if you look at even the process skills, in science its very difficult and the stuff on terms. Take for instance if you go for Grade 5, going for the properties of metals. Each property there, if you say the metals are malleable, that malleability, you need to undergo the whole period interpreting the very same term. For them to understand as to what I must have a variety of kinds of metals trying to hammer this so that they would be able to understand that this is malleable. Now, when are you be able to, to , to finish up? If you say this is rusty, its one property but it's a lesson in itself. If you say metals are… some metals are magnetic, you must come up with the metals that are magnetic and those who are non-magnetic. And then it takes a lot each time. So we ended up brainstorming the section and even today I was visited by the curriculum advisor. I was really frustrated because now because my learners don't even know the properties of all what we did. And I do have classworks and then they but now I'm just revising because I told you that I'm already and then the one said its fine, I just want to see what you are doing but, from the very onset, when you ask for properties they give you examples. So, I took it back to basic to remind them with the object that we used, this is a can, its been hammered to and its flat now trying to get them to remember and he even engaged with them trying to explain to them. So I say in that the most challenge that we have in science is time allocated to science	Time for terminology	10

THEME: Knowledge of learners - Awareness of learner prior knowledge (Code: KofL Pknow)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	1531-1544	Viwe: Most of the times I find that... most of this er skills, I apply them. Because I like today I was busy trying to find out if kids can recall from term 1. Since like there's examination next week, it covers term 1 and term 2.	Grade 6 group	10

THEME: Knowledge of learners - Awareness of learner prior knowledge (Code: KofL Pknow)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
		Nomvuyo: Ok. You mean the cognitive? Viwe: Recalling of information but you find that they can classify and find out if they can compare. Like for example today I was teaching, I was teaching difference between mixtures and solutions and then now I was looking at the textbook. It told me that a cup of coffee is not a solution. Nomvuyo: mm-hmm Viwe: But if I can ask my colleagues, they'll tell me a cup of coffee is a solution. And then... and the reason why it was looking at the facts about the part... arrangement of particles. Which one can dissolve? Which one cannot dissolve in that way? So we normally use this but sometimes its unknowingly. But, the problem is when it comes to setting the examinations. Mid to level questions, lets say higher order, so we find out that we look at ... we want the kids to pass. So we try to just have lower order to middle order, not catering for the higher order.		
TAT5G2	878-879	Daluxolo: Because some kids they think that the glucose or food (inaudible) they might not know that this is the food that	Talking about why photosynthesis is important	10
TAT4G2	401-403	Thenjiwe: (inaudible) to plant a big one here before beginning however she decided to find out what the learners knew and thought about the concept of biosphere and the requirements for sustaining life		9
TAT4G2	416-428	Lwazi: Go to the second one what information was there that pre-existing knowledge Thenjiwe: Part of the pre-existing knowledge Thembani: Previous knowledge previous pre-existing knowledge Thenjiwe: What does it here Lindiwe: Requirements for sustaining life but there Thembani: Knowledge knowledge about the biosphere Thenjiwe: Mm biosphere only Lwazi: Biosphere and the concept of Thenjiwe: And the concept of Thembani: Biosphere Thenjiwe: The concept of biosphere Lwazi: Biosphere and the requirements for sustaining life		9
TAT4G2	890-900	Lwazi: Habitats at the end of the unit of the need a habitat the teacher asked her grade four class to write down answers to the following questions to see how they were able to apply the ideas she had hoped they had grasped. So there is the questions. But anyway this is this is a formal assessment Thenjiwe: Ja so it's a yes what information was gathered the adaptation of living organisms ne in their habitats Lwazi: The thing to see how they were able to apply their ideas Thembani: Application Lwazi: Its application Thenjiwe: Application of knowledge Lwazi: Yes it's application of knowledge there		9
TAT4G2	1102-1109	Akhona: A the first one the learners used it in the form of a labelled drawing but actually it was the teacher that got the prior knowledge Sue: Ja okay so it was the learners were doing the activity but the teachers were were using the assessment that they did to get the prior knowledge and then how was the teacher going to use it or how did the teacher use it Akhona: She was hoping she was getting a baseline test she was hoping that through that she would (inaudible) their understanding of what they knew about the biosphere		9
TAT4G2	1048	Man: Finding a misconception that the learners knew before the tropic		9
TAT4G2	1080-1081	Man: So that's why they say (inadible) asking questions about what what (inaudible) trying to find out about what they've learned		9

THEME: Knowledge of learners - Awareness of learner prior knowledge (Code: KofL Pknow)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT4G2	1357-1359	Thenjiwe: And now out of that activity he gets information on how must the learners know and then he prepares mighty plans now on how he can support the learners		9
TAT3G1	1041-1053	Akhona: What do we know about learner thinking? Mlondolozi: We talking about reproduction, reproducing of the same species Lwazi: Mmm Phumza: Learner thinking Mlondolozi: Mmm Akhona: I think we need to say there is prior knowledge. What do we know about learner thinking? They have the prior knowledge with the angiosperm. Remember, we had to do Mlondolozi: Yes, yes. They did the whole of the plant thing. They did the whole Akhona: Yes Mlondolozi: So there is prior Akhona: Angiosperm and from that human reproduction. In the previous, prior knowledge in the previous chapter of Lwazi: reproduction	Curriculum knowledge/ Prior knowledge	7
TAT1G1	116-119	**Viwe:** Ja it was nice and to know what was going to be expected. I think it's important especially at a senior level and even at a junior level for kids to know what it is that they're going to adventure upon. What I do think could have possibly been before the movie, is like just an introductory discussion on biodiversity. Not not to tell the learners what it is. **Akhona:** Yup **Viwe:** But just to get reports and perhaps even their misgivings on on what they think uh biodiversity is	Establish prior knowledge	1
TAT1G1	1230-1236	Akhona: There's an overlap quite remarkable Mlondolozi: Some of the prior knowledge the learner knows what they know from previous years and what they expect to know the (unintelligible) continuity and the coherence of what (unintelligible) development Mediator: Okay so you could see some continuity and connection ja from grade to grade Phumza: And from the terminology they can also construct sentences(unintelligible) using the words that they are having	Prior language knowledge	3

THEME: Pedagogical knowledge - Teaching strategy (Code: PK TStrat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT1G1	106-108	Akhona: It was really useful to be given that in the beginning because immediately my attention was then drawn to the outcome Mabhuti: Ja it was. You knew then what was going to be expected.	Teaching strategy	1
TAT1G1	114-119	Viwe: Ja it was nice and to know what was going to be expected. I think it's important especially at a senior level and even at a junior level for kids to know what it is that they're going to adventure upon. What I do think could have possibly been before the movie, is like just an introductory discussion on biodiversity. Not not to tell the learners what it is. Akhona: Yup Viwe: But just to get reports and perhaps even their misgivings on on what they think uh biodiversity is	Listening with intent - Impact of purpose Establishing learner prior knowledge	1
TAT1G1	141-144	Viwe: So perhaps do it as you said. Have the short introductory discussion, show the movie without giving them instruction so they can watch it and just view it, just tell them (inaudible) not telling them what it is. Then after that giving them that, make individual notes, after which you show the video again. Now they know this is what I was supposed to listen to	Lesson planning on how to use the teaching strategy	1

THEME: Pedagogical knowledge - Teaching strategy (Code: PK TStrat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT1G1	182-194	Akhona: We'd like to be very um …our group decided that it was really nice to know exactly what the expectation was before the lesson started, so to have clear direction meant that my focus was immediately on the task which I believe children need. If you had spoken to me about biodiversity before hand and I'm still bending down picking up my pen, and looking around and being distracted. But I knew from the outset that I was going to have to watch this carefully and that I would be expected to write down what I've seen so immediately my focus was geared to what I had to do. So that was of great value. The only thing we felt as a group would be beneficial for our learners is to have watched it the first time and then to watch it a second time. Once we got feedback, a second time would be quite valuable because then the comments are more meaningful	What their strategy would be and why - pedagogical reasoning around how to present the content	1
TAT1G2	62-64	Daluxolo: I think those terms that we're talking, the five E's thats engagement when you're engaging and exploring that you engage and then you explore, then you actually further in the group and you explain and then you negotiate. And she, she was facilitating.		1
TAT3G1	686-706	Akhona: Here, look here. Probes. Probes are student questions of student understanding. That's why I pointed this out. So my start would be 'question learners'. Question the learners understanding. That's the first thing, okay? Mlondolozi: I have projects in the classroom they are not learning it Lwazi: You can even add the five E's as one of the procedures. Like questioning would be about engaging that is ja, that is … Akhona: Yes. Definitely Mlondolozi: An example of those five E's Akhona: Yes Phumza: The prior … engaging they are or are questioning their prior knowledge. What would they know? Akhona: Yes Phumza: And I think this another is they teach … they talk, talk about active learning. The discussions discussion would be would be fine because you want as if you are challenging them because you ask from them what do you understand? Akhona: That's it. What teaching procedures okay, then we've also got to teach them um, active learning. We've also got to teach them concepts, haven't we what does variation mean? Lwazi: Mm yes exactly Phumza: Term terminology Lwazi: Terminology yes Akhona: Of variation. Ja, okay.		7
TAT3G1	927-935	Akhona: That annoys me because that makes so much more sense than this rubbish in this textbook Mediator: And it's visual which I mean learners are so used to Akhona: Exactly Mediator: A visual input Mlondolozi: Hey that's a thing, ja Mediator: Hey they will sit and they will listen Mlondolozi: Yes Phumza: They will sit and listen and there there there are also pictures there that they can see like that egg	Movie as teaching strategy	
TAT3G1	1351-1366	Bar graphs, histograms, measure and collect information, pictures videos for teaching about variation	Teachers pooling their ideas	
TAT3G1	1814-1840	Akhona: They had to … I first taught the lesson, I've got a powerpoint for that and I talk (unintelligible) must do then they had to bring the flowers from the roads, the hibiscus from the roads, then they cut it, they opened it up, then we took the leaves off the petals sorry the petals off. Then they just left with that middle piece the stigma and the stamens and they had to look at that with a magnifying glass cos we got the little magnifying glass things had to look at them through that then we removed this and they cut out (unintelligible)and we could see the pollen and everything	Teacher sharing her lesson	
TAT3G1	1877-	Lwazi: What I do and then we caught (unintelligible) you see	Lwazi shares the	

THEME: Pedagogical knowledge - Teaching strategy (Code: PK TStrat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
	1895	observation over 14 days and after the seed has germinated so they taking down the notes. So I take it further we go into produce the line graph. Akhona: A ja ja Lwazi: A line graph that was. I'll send you a template of what I do there because it starts off with a hypothesis Akhona: Ja that's right Lwazi: We start of with what investigation am I doing, then come up with a hypothesis, then state the apparatus then the method then they put the table of results then they produce a graph Phumza: So it's more than grade 4 is what you are saying. It's more like it's it's extended Lwazi: It's extended Phumza: Than grade 4 (unintelligible) Akhona: Its building up to the whole cycle, the process Lwazi: Its building too. Because it involves a lot it's got tables making tables, recording of results, making tables and we've got also um observations Phumza: You know what on this on this flower that you Akhona: Yes Phumza: If if if our learners could go and buy some stuff we would make we would make a lot of practical because one time when I was (inaudible) they said from the Coke bottles, from the 2 litre.	teaching strategies behind his bean lesson	
TAT2G4	146-158	Lindiwe: Then she takes them, she lets them read an aerial map and now they doing map reading which links to geography Zuko: But when they read the map they will come up with their own conclusion because the map will just come as a map and then they will come up you know Lindiwe: I'd say she lets them read the map to show them, to identify the source of the pollution so they have to look at the map and then Zuko: And then (unintelligible) Lindiwe: Show them what happened they have to go find where does this river start Zuko: Mm it's creative thinking skills Nomsa: So the (unintelligible) Lindiwe: So it's critical skills ja Zuko: In terms of creative teaching strategy this one develop critical and creative thinking skill Nomsa: And creative thinking skills so that would come here again	Teachers identifying purpose and teaching strategy	5
TAT2G4	208-216	Lindiwe: And then she's going to take them on a field trip Nomsa: There but it's also active learning Lindiwe: Now they going to do this Nomsa: Testing the quality of water Zuko: Local river to the local river ne Lindiwe: Mm taking them to the local river Zuko: To take test kits hm test kits to test the quality of water so it's (unintelligible) going to be a practical lesson Lindiwe: Mm so it's going to be a field trip they going to be outside	Identifying teaching strategies	5
TAT2G4	330-336	Lindiwe: And then they going to use mathematical concepts also because they going to take water it's going to be five mls Zuko: Ja Lindiwe: And they going to do something whatever whatever to test it Mediator: Yes Zuko: Mm Lindiwe: To develop mathematical concepts and develop critical thinking skills in my opinion	Identifying purpose of teaching strategy	5
TAT2G4	245-249	Zuko: Observation skills Lindiwe: But they going to do it. She's going to give them field test kits Zuko: Mm test kits Lindiwe: So they going to do it themselves. They not going to observe. They actually do it themselves Zuko: To discover	Identifying purpose of teaching strategy	5

THEME: Pedagogical knowledge - Teaching strategy (Code: PK TStrat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT2G3	155-162	Daluxolo: Ja teaching strategy so (unintelligible) Buzwe: Creating a text or something Buzwe: Ja text from the ah mm text from the book Fezeka: Mm Buzwe: When they say ee (unintelligible) a section from the book is it supposed to be a text from the book Fezeka: Mm mm Buzwe: But what is the the goal of that? what is the purpose or goal? Daluxolo: (unintelligible) reading there it says read reading a section in their textbooks	Working out the teaching strategy and purpose	5
TAT2G3	253-262	Buzwe: And then from there she also gives them an extract from a newspaper article Buzwe: A newspaper article Fezeka: On a pollution spill in a local river that was reported a year before. So here it's an extract from newspaper Buzwe: Extract Khuthala: So Fezeka: It's an extract she also gives them an extract from a news article (unintelligible) Buzwe: So so so it goes what under what Fezeka: Extract goes under this Daluxolo: It's a case study I'm looking at case study	Identifying the teaching strategy	5
TAT2G3	291-297	Mediator: So why do you think she gives an extract? What would have been the purpose of giving a newspaper extract about pollution in the local river? Buzwe: To link the learning with everyday life Mediator: Ja Buzwe: Experience Mediator: Absolutely okay Buzwe: Linking people with where they come from what is happening	Mediator prompting	5
TAT2G3	346-350	Daluxolo: Yeah now but they doing some analysis aren't they? Buzwe: Mm Daluxolo: They analysing something Buzwe: Read an aerial map showing again again for (unintelligible) of the pollution (unintelligible) then she takes them to a local river but this is not for … for a field trip (unintelligible) three	Analyse, interpret, investigate - not clear distinction between these	5
TAT2G3	389-393	Daluxolo: (unintelligible) interpret information from reading Buzwe: Ja that's good that's good Fezeka: Mm Buzwe: Of of analysing analysing it (unintelligible) interpret everything but most (unintelligible) Daluxolo: Analysing but they not analysing (unintelligible) because they are reading the map	Analyse, interpret, investigate - not clear distinction between these	5
TAT2G3	417-425	Buzwe: Analysing media such as advertisements analysing media Khuthala: Oh is it not learning by doing? Buzwe: How? Local Khuthala: Local actions to address an environmental issue or a practical Daluxolo: This one here it looks closer to this Buzwe: Local issues but here Daluxolo: Mm Buzwe: It's more closer to working with camera Buzwe: With camera?	Identifying strategies	5
TAT2G3	480-486	Daluxolo: I think a lesson has to comprise of a diversity of teaching methods. You have to use different teaching methods Mediator: Ja Daluxolo: To come up with the lesson Mediator: Okay Daluxolo: So it at least becomes interesting to the learners as they are not um they'll be not be doing one thing or	Feedback on activity	5

THEME: Pedagogical knowledge - Teaching strategy (Code: PK TStrat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT2G3	500-510	Akhona: I was just encouraged to see that again its that investigate, plan, act, check, reflect and all the processes even on the things we Mediator: Ja Akhona: It reinforces the importance of those process skills Mediator: Yes Akhona: Those concepts Mediator: Say that again it was Akhona: Investigate, plan, act, check when you did your test or kit, you were checking Mediator: Ja Akhona: And again reflect so you going back to record that then you again looking at you know finalising it so it's that whole scientific experiment process	Reportback on Activity 5 by Group 1	
TAT2G3	572-573	Mediator: So what I am doing is I'm giving you an instruction and then I'm scaffolding it for you by providing you with the vocabulary okay that's my teaching strategy alright	Mediator making teaching strategy explicit	
TAT2G4	125-132	Lindiwe: Extended reading Zuko: The purpose is to is to Lindiwe: To bring the context the stuff in the textbook into their everyday life Zuko: Ja to to to link Lindiwe: To link the the textbook to the Zuko: To link the learning context to the real life challenges to link teach to link the learning con context context to real life learning challenges	Purpose of reading	5
TAT2G4	136-141	Zuko: Teaching strategy doing that oh it's also active learning ne Lindiwe: It's also active learning ja because they have to Zuko: Mm be active to read Lindiwe: They have to they can't just (unintelligible) Zuko: They have to know they they can get information somewhere not only from the teacher and textbooks mm active learning	Is reading active learning?	5
TAT2G4	376-381	Nomsa: Writing to learn Lindiwe: The purpose or the goal would be to put their thoughts into logical Nomsa: To Lindiwe: Logical order putting their thoughts into logical order Zuko: Putting their thoughts into logical order Lindiwe: Summing up their their results	Purpose of writing a report	5
TAT2G4	280-285	Zuko: So we say it's active learning Mediator: Okay alright Zuko: Not necessarily to learn at school. They learn everywhere Mediator: Yes okay, but all the teacher did was ask them to read it. So we assuming that there was active learning but the actual activity or the actual thing of giving them something to read - that's reading, reading and writing to learn	Over-generalising learning to beyond what happens in the classroom	5
TAT5G1	232-241	Akhona: Are we okay do we know what this how this works okay let's take this one first so what we supposed to do with our questioning techniques we supposed to decide in terms of knowledge what do we want our children to know do we want them to have a factual knowledge Phumza: Yes Akhona: Do we want them to have conceptual knowledge in other words the concept here it tells you classification, principals of generalisation, theories or models okay so that is where this fits in do we want them to know procedural knowledge so things like maths subjects okay so it's there you see the connection there but if you want them to know factual knowledge there then those are the skills we going to use these are the factual skills this was the knowledge so if I want them to know factual like how many of this and when did this and why did this then I'm going to look here and I'm going to expect them to remember facts		10

THEME: Pedagogical knowledge - Teaching strategy (Code: PK TStrat)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	1548-1554	Group 1 Akhona: But Nomvuyo, I've realised though that with us teaching and with the volume as Viwe was saying, what concerns me is that I'm now having done this today I see how I'm teaching to be able to test. Nomvuyo: Mmm Group 1 Akhona: And that should never have been… should never have been … that's been an eye opener for me. Is that my… I've lost … I think I've lost the point of… of the children. I'm thinking differently about it now. Because of chasing content. So, that's a worry.		10
TAT4G2	607-615	Lwazi: Both of them used it so that one is gone done seen processes to purify water at the end of the topic their topic the teacher held a discussion with the whole class about how to purify water so that others could understand it the learners the learners ended up with a list of points to remind them what had been done what had been found how it could be explained the teacher wrote these is large in large print on a chart and put it up on the wall while the learners wrote a report they were reminded to pay attention to the points listed when they presented their reports to each other they used the list to make constructive comments about how they how the reports could be improved constructive comments okay so was it an assessment yes	Teaching strategy	

THEME: CAPS focus on assessment (Code: CAPS)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	1578-1598	Nomsa: Sorry, Nomvuyo, I .. the other thing is this also. With the textbook and with what the department sends, you can only adjust what they give you. You can't add in your own when it comes to an examination. I don't know about the others but for CAPS … Nomvuyo: Are you writing a common exam? What do you mean you can't add? Nomsa: There's one in the textbook and there's one that the department sends you. You can't ex.. take out or… you have to use it as it is. Khuthala: You have to use it. Nomsa: So that, that is also my worry, that we can't add our own. We just have to use what they give us, but we can adjust in that... Nomvuyo: What I'm asking are you writing the term exam, common exam, which is set by the department of education? Nomsa: We can adjust it … with the textbooks one and the one that they give us but we have to do … we only have to use what they give us. We can't… out of my own I can't write up a question. Nomvuyo: No, what I'm saying is what is coming from the department of education is a common exam? Nomsa: Yes, it is a common paper Nomvuyo: It's a common exam. Nomsa: Yes Nomvuyo: They say that you can adjust that … because the context is different Nomsa: No we couldn't. We weren't allowed to. Sonwabo: The department one was full of errors and we tried to use it for example at my school. But we find we were disappointed there were a lot of errors, in the departmental examination.		
TAT4G2	338-343	Akhona: It was very so-so. In the CAPS training that I did, assessment was glossed over what assessment meant very quickly the knowledge implication as to what had to happen every term, then we were supposed to (inaudible) higher order thinking skills um … Nomvuyo: And what else? Alright (inaudible) Lwazi: The assessment was just rushed through	CAPS focus on assessment	

THEME: CAPS focus on assessment (Code: CAPS)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT4G2	953-958	Lwazi: We are looking at it from CAPS you don't do you get information from it's more from the National Curriculum because you assess based on the requirements of the curriculum the book assists you Thembani: All the books which are caps align are taking it from the CAPS document Thenjiwe: From the CAPS curriculum		
TAT4G2	1397	Lwazi: You teaching for assessment		
TAT4G3	428-431	Sonwabo/Khuthala: I agree with Nandipha about time because most of the time we find out that because of this recent curriculum you you are teaching to ass assess, not teaching for understanding. You are teaching to assess to cover what the CAPS document want you to cover, not what you want the kids to understand. So whether the kids understand you		

THEME: Context (Code: Context)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	1021-1042	Viwe: And also I did the physics boiling water Phumza: Mm with the salt I also did that one Viwe: The evaporation one I also did Phumza: They were so excited when they see that salt coming out form that from the water because we don't have we don't have the lab we use the stove Akhona: Ja Phumza: We used the stove and the pot and then they could see what they were supposed to do Akhona: Sho Phumza: In in the lab Lwazi: I have I have this (inaudible) Phumza: You said your school have everything mine doesn't have anything what happened yesterday my child she she's there at Claremont she came back and said you know mummy our principal our teacher was in grade 7 he told us that she's doing grade 6 Viwe: Ja Phumza: In Grade 7 they were doing evaporation taking out the salt from the water I was like how how did your teacher do he said to me he did that in the glass beakers and all those stuff and I was like we don't have those things but I did it also how mummy I used the pot and the stove how mummy show me I had to show her in the house what I did and then she was like but you don't have labs then I said we don't have labs so I have to use what I have so that my children can know Akhona: You have a stove at your school Phumza: We are doing feeding scheme at our school	Resources	
TAT2G4	983-990	Lindiwe: You know I had a lecturer at college who told us that if you ever want peace to bring children to the point where they quiet you must speak softly not shout you must actually speak softly with respect to the child right there in front of you ne and they (unintelligible) because they want to hear what you are saying to the child in the front Zuko: Oh Lindiwe: And I've got a very loud voice but I also can't speak at a high voice for too long so what I do is look at the child right in front of me (unintelligible) and obviously they going to engage and they go like sh sh	Classroom climate – Sharing discipline ideas	

THEME: Context (Code: Context)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT2G4	995-1011	Nomsa: It's difficult to sometimes keep control (unintelligible) I had them for I had the other one for (unintelligible) so they know you they know you so when I (unintelligible) Lindiwe: (unintelligible) other methods Nomsa: Because they are now starting to (unintelligible) Lindiwe: (unintelligible) must stand in the corner with their back to the class Nomsa: Ja Lindiwe: They become invisible (unintelligible) stand there facing the corner because you wanted to be a clown so be a clown to yourself there in the corner whoever talks to him will be there next I write the name down on the board (unintelligible) they don't want to be in the corner because (unintelligible) Nomsa: Yes that's right Zuko: There in that corner they they are in the view to see Lindiwe: No there's nothing there in that corner everything happens behind their back Zuko: But according to the law Lindiwe: No there's no law in that place I'm the law because if you don't do that the children don't like to be excluded you know as soon as you exclude them then they they kind of (unintelligible) themselves back to (unintelligible) Zuko: (unintelligible)	Classroom climate – Sharing discipline ideas	
TAT2G3	524-525	Phumza: I think these these method would be yes they are good but for our learn for our number of learners in our classes it's going to be too hard	Class size	5
TAT5G1	1127-1150	Phumza: They don't bring anything these children you ask bring this bring that they don't bring you have to go and (inaudible) yourself Akhona: (inaudible) they are they are a generation that don't see the point Viwe: Unmotivated Akhona: Are they unmotivated though do you think that's (inaudible) too much spent on them for their own good Viwe: Ja they so used to getting Akhona: If you don't bring your boards and you don't bring the litmus paper we can't do the experiment (inaudible) they didn't bring it Phumza: And then they don't mind even if you give them that zero give them zero just like that Akhona: Ja Phumza: Look here we doing structures in Grade 4 they're making the the tower then I told them that they must submit I gave them the whole week last week Friday it was the due date only three came with their structures then on Monday I asked them again I had to be firm by giving them a two (inaudible) and then Akhona: (inaudible)what our teacher does now he collected projects from the previous years Mlondolozi: Mm Akhona: And because he can't rely on them bringing it anymore he broke the kids broke them down Phumza: Mm Akhona: They leave it there he says rebuild it in your break times after school there it is then the kids got the project otherwise how does he give the child a mark so it's very sad Phumza: And then (inaudible) give them a new assessment then they say even if we didn't give in something but at the very last day you must go back to term one's work that they did and give something you see so we will just give them their mark even if they're not there	Motivation and apparatus	

THEME: Context (Code: Context)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	1414-1420	Akhona: I can't take them to Kirstenbosch Sue: No (laughter) Sue: You'll have to bring Kirstenbosch into the classroom they do classroom visits Akhona: But only to um the privileged Sue: Okay Akhona: The Northern Suburbs is sort of an island out there somewhere so ja okay	Access	
TAT5G1	1562-1569	Grade 6 Viwe: And that's the thing Nomvuyo. We don't like have the apparatus for the kids to investigate and like observe or whatever. So I try to use a real life, so for them so that it makes sense for them. For example, er, I was looking at the solutions like factors that effect the rate of dissolving, for example. I looked at … now if you look at the coffee you buy from KFC and the coffee you are making at home, its different. 'Cos at KFC they heat the milk. But at home we don't do that. If you lucky you put your cup of coffee in the microwave and then I look at why do we do that? And what's the reason? Now makes sense to them. Oh, now it makes sense. Trying to use what you are teaching in class and relate to real life situation.	Apparatus	

THEME: Groupwork (Code: GW)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT1G2	82-90	Thembani: In this group, they have been talking about one of the philosophers called J. S. Farrond. In one of his contributions in his book on philosophy of education he brought out that every human being is going with gregarious tendencies. Gregarious tendencies means that every human being has got a tendency to associate with others. You can't live in isolation. So as teachers we must incorporate the philosophy by engaging learners in group work, so I will bring that under the shared recall Mediator: the shared recall Thembani: We have come together as a group – this one brought this thing, this one brought this thing, and we come up with one common thing		1

THEME: Mediator Content Knowledge (Code: MCK)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT3G1	48 - 55	Mediator: I would like to say something about your variation topic. Um, I included a sheet which showed the content and then I've made some notes. Ok. I was a bit confused about how this is presented in CAPS. There's some glaring errors to my mind and I just wanted to flag those for you. When I'm looking at the material from other countries I am seeing exactly the same kind of activities but, but not the same mistake. The main mistake that I feel that they are making here is that they are saying you must record the heights of learners in a bar graph. Ok. And that's not correct because … you … and then they talk about an x- and a y-axis ok, and as we know on a bar graph you don't have, um, an x axis as such because you have different categories going along the bottom. There is no …	Correcting CAPS and goes on to explain difference between bar graph and histogram. Also 218-225	

THEME: Motivation of learners (Code: Motivation)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	1124-1133	Phumza: They don't bring anything these children you ask bring this bring that they don't bring you have to go and (inaudible) yourself Akhona: (inaudible) they are they are a generation that don't see the point Viwe: Unmotivated Akhona: Are they unmotivated though do you think that's (inaudible) too much spent on them for their own good Viwe: Ja they so used to getting Akhona: If you don't bring your boards and you don't bring the litmus paper we can't do the experiment (inaudible) they didn't bring it Phumza: And then they don't mind even if you give them that zero give them zero just like that		

THEME: Resources and class size (Code: Res)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT1G1	122-125	Viwe: Ja, ja. But being realistic, yes some of us do it in smart schools and do have the capabilities already to show movies like this. But the sad reality perhaps, is that most of us are faced with classes that reaches fifty learners so how something like this, how are you going to keep it constructive in a scenario like this? Akhona: I would in terms of this lesson I would definitely show the video again.	Resources and class size	1
TAT1G1	164-168	Mabhuti: So you don't write on a board at your school you don't use your blackboard? Akhona: No we don't have any. The children suffer from allergies (laughter) Viwe: We're also lucky enough to have whiteboards but I don't usually use the white board, I have powerpoint presentation Akhona: Oh ja. I also do that.	Classroom resources - instrumental context	1
TAT1G2	158-159	Phumza: But what about saying equity in science, and then saying there's no equity in science because some schools have apparatus and resources for science whereas others they don't		2
TAT1G2	173-179	Phumza: The ability to become strong, healthy or successful again after... mm examples finding new ways of survival after being retrenched Sue: Okay resilience after retrenchment that's ja okay Phumza: And then relevance to population: If you are in size class you don't have resources in your class you have to improvise Sue: Oh that's a lovely example of how as science teachers one's often in a situation where you have to be resilient ja okay right that's great okay thanks and this last group um adaptation		2
TAT3G1	1843-1845	Phumza: But the problem we don't have that powerpoint Akhona: Would you like the powerpoint?	Teacher shares ppt	
TAT3G2	139-148	Sonwabo: But you know what eh there's something (inaudible) with South African science. There is no link to the Department of Education over this Science and education organisations because if there was a link we can you can aim to improve in the classroom teaching because Sue: Ja Sonwabo: The question in the end that I've got I can never improve but this I cannot do anything about this resources Sue: Ja Sonwabo: Yes you can improvise the question again is how far can you go without the support from this group	Talking about the PSP materials - tha tthey don't get them in schools	7

THEME: Resources and class size (Code: Res)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT3G2	894-899	Sonwabo: It's not about 'what about the CAPS subjects?' but about 'can the kids grasp the concept we are teaching them?' I don't know what that's what I think as a science teacher (inaudible) because no, my kids failed Natural Science the first term and the second term. Someone suggested to me to use PowerPoint and then second term I start with (inaudible) In my Natural Science lesson I used PowerPoint because I don't have materials the kids they don't know what is going on. They don't understand abstract	Lack of resources means your teaching is abstract	7
TAT2G3	21	Buzwe: Those those worksheets are interesting activities	Course resources	

THEME: Teacher misconceptions (Code: T Mis)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT3G1	518-562	Interbreeding misconceived by teachers to mean cross-breeding	Language issue	

THEME: Teacher beliefs (Code: Tblf)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	1124-1133	**Phumza**: They don't bring anything these children you ask bring this bring that they don't bring you have to go and (inaudible) yourself **Akhona**: (inaudible) they are they are a generation that don't see the point **Viwe**: Unmotivated **Akhona**: Are they unmotivated though do you think that's (inaudible) too much spent on them for their own good **Viwe**: Ja they so used to getting **Akhona**: If you don't bring your boards and you don't bring the litmus paper we can't do the experiment (inaudible) they didn't bring it **Phumza**: And then they don't mind even if you give them that zero give them zero just like that		
TAT5G1	1380-1392	Akhona: Correct and this is so necessary I (inaudible) cos what it's telling me here is we should actually teach according to the test in that context Sue: Ja Akhona: And that's not good that's not learning am I right Sue: How how do you mean teach according to the test Akhona: Well if I'm describing conditions um that support life okay Sue: Ja Akhona: And it's fallen under the lower order remembering Sue: Ja Akhona: So therefore it's category number 12 in the process skills right recalling information Sue: Ja Akhona: Now it comes to the test so it's all about water and sun and oxygen and respiration blah blah blah so in my test I haven't moved		
TAT5G1	1507-1510	Group 1 Akhona: Reflection. I thought it was was very, very interesting. Bringing together the formative and the summative, that for me spoke volumes because it made me realise that so much of what I'm testing that I thought was so hard, is actually middle order! So I'm going back tomorrow to look at my exam paper.		

THEME: Teacher beliefs (Code: Tblf)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT4G2	171-180	Lwazi: Diverse is it the children that we are looking at you not only looking at um you not only looking at Thenjiwe: (inaudible) Lwazi: (inaudible) an academic child a child who have you have some who are vocal you know the the the what do you call them Lindiwe: Talented Lwazi: Multi no not multi-talented I wanted this word (inaudible) where you look at the different Thenjiwe: Mm hm Lwazi: Methods by which children learn		
TAT4G2	314-320	Woman from another group: To, to give benefit of to to to give others who couldn't master one of the assessment which is given by the teacher so… not all the children are the same in the class. Some are in the (inaudible) and others are in the middle So that means we are given the opportunities to those which is to reach the other learner.	diversity	
TAT4G2	672-675	Lwazi: I have assessed you see in a way if you have learned something you have made an assessment Thembani: Yes Thenjiwe: Mm the assessment is not for learners only its two way traffic		
TAT4G2	783-787	Lwazi: You give pointers to the children because they if you see a children going the wrong way you bring them back into the right way isn't it Thenjiwe: Mm Lwazi: How do you bring them in the right track? You assess where they are and you lead them into the right track	Formative assessment	
TAT4G2	826-827	Lwazi: And you give them pointers because you don't just give pointers from nowhere you give pointers after looking at what they have given you	Formative assessment	
TAT4G2	1154-1164	Man: I agree with Nandipha about time because most of the time you find out because of this recent (inaudible) you are teaching to assess not teaching for understanding you are teaching to assess to cover what the CAPS document want you to Nomvuyo: To cover Man: Not what you want the kids to understand so whether the kids understand or not is not effective because they want you to cover those concepts so most of the time you find you are teaching to assess and not the other way around so the kids the kids that's why the kids are struggling to relate whatever you are teaching the class with real life Thenjiwe: We are teaching for fun because they know nothing		
TAT2G3	480-486	Daluxolo: I think a lesson has to comprise of a diversity of teaching methods. You have to use different teaching methods Mediator: Ja Daluxolo: To come up with the lesson Mediator: Okay Daluxolo: So it at least becomes interesting to the learners as they are not um they'll be not be doing one thing or	Teacher beliefs	
TAT2G3	512-513	Thembani: (unintelligible) the voices. Learners are a passive recipient of of of knowledge and ushers them into active participants of learning.	Change of belief expressed during reportback	
TAT2G4	85	Lindiwe: I think that's active learning because they going to read themselves	Reading is active learning	

THEME: Time as an issue (Code: Time)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT5G1	1515-1519	Group 1 Viwe: So basically as what he said, um, a lot of things that I'm supposed to do that I'm not actually allowed time to do. Um, because the curriculum is so packed. Because of the volume of work that you have to … that I need to get through. We need to get through. Um, its not easy. Its not easy applying all of these, um, principles to each and every lesson, to each and every concept, each and every topic. Um, so yes, opened my eyes again to what it is that we need to focus on.	Time as an issue - curriculum	
TAT5G1	1621-1636	Zuko: What I've learnt is that er, the most challenging that we are having, especially in sciences, is the time allocated for science. Because if you look at even the process skills, in science its very difficult and the stuff on terms. Take for instance if you go for Grade 5, going for the properties of metals. Each property there, if you say the metals are malleable, that malleability, you need to undergo the whole period interpreting the very same term. For them to understand as to what I must have a variety of kinds of metals trying to hammer this so that they would be able to understand that this is malleable. Now, when are you be able to, to , to finish up? If you say this is rusty, its one property but it's a lesson in itself. If you say metals are… some metals are magnetic, you must come up with the metals that are magnetic and those who are non-magnetic. And then it takes a lot each time. So we ended up brainstorming the section and even today I was visited by the curriculum advisor. I was really frustrated because now because my learners don't even know the properties of all what we did. And I do have classworks and then they but now I'm just revising because I told you that I'm already and then the one said its fine, I just want to see what you are doing but, from the very onset, when you ask for properties they give you examples. So, I took it back to basic to remind them with the object that we used, this is a can, its been hammered to and its flat now trying to get them to remember and he even engaged with them trying to explain to them. So I say in that the most challenge that we have in science is time allocated to science	Time for process skills nd practical work	
TAT4G2	1394-1409	Thenjiwe: There's no time for making evaluation (inaudible) evaluation of the formal assessment you give them the test the next day you teach something new you don't have time Lwazi: You teaching for assessment Thenjiwe: Ja you teaching for assessment because you don't have time to evaluate so that you can improve on your methods that's why you having the same results because you don't improve Lwazi: We don't improve Thenjiwe: We are not improving because we are rushed for time Lwazi: All the time we rushing it's the curriculum it's content based Thenjiwe: Ja it's content based ja Lindiwe: Not much time for consolidation Thenjiwe: Mm Lwazi: We have a lot to achieve in that short period of time there is no time left for either you have to do a revision or put in a lesson repeat a lesson somewhere in between otherwise that has to come in in a different remedial time	Time as an issue - assessment	

THEME: Time as an issue (Code: Time)				
SOURCE	**LINES**	**EXTRACT**	**NOTES**	**ACT**
TAT4G3	428-441	Sonwabo: I agree with Thenjiwe about time because most of the time we find out that because of this recent curriculum you you are teaching to ass assess, not teaching for understanding. You are teaching to assess to cover what the CAPS document want you to cover, not what you want the kids to understand. So whether the kids understand you Thenjiwe: or not Sonwabo: is not applicable because they want you to cover those concept, so it's a lot of time you find yourself that you are teaching to assess not the other way around. So the kids the kids that's why kids are struggling to to relate this whatever you are teaching in class with real life. Thenjiwe: We are teaching for fun because they know that they … Lindiwe: Okay what I found is that when I give them an activity in the class, then I can give them a certain amount of time to do it and then I tell them we going to take ten minutes to do the answers of that activity because that is reflecting back to did they understand what we were talking about	Time as an issue - assessment	
TAT3G1	658-663	Mlondolozi: Any other factors? Akhona: Time constraints Mlondolozi: Mm, Mm Akhona: Because of those, it lends itself to so much discussion. Do you do discussions? Then you've got to discuss the myths and you got to talk about all the cultures and you know all the discussions that take place	Talking about difficulties in teaching about variation	7
TAT3G1	1446-1452	Mlondolozi: (Unintelligible) you don't do two practicals for one topic it's very difficult because you have to rush them Lwazi: Ja Mlondolozi: So you don't have much time to to do all these things Phumza: Mm Akhona: You right Mlondolozi: You can just do one activity	Practical work takes time	7
TAT3G1	1488-1494	Lwazi: You'll do it in two years if you follow everything Mlondolozi: Ja Akhona: I hate every minute of it Lwazi: Mm mm Mlondolozi: Cos there is so much content that you need to cover Lwazi: Sho Mlondolozi: That if you do every activity	Time for CAPS	
TAT3G2	107-109	Sonwabo: The questions is 'what are the limitation of teaching the topic living and non-living things in an eco-system'. I think the limitation for you to go out and use the hands on approach. It's difficult because of time. Time is a factor also	Time for practical work	7

Appendix I Analytic Memo 3: Document analysis

ANALYTIC MEMO 3 Document Analysis

Documents analysed:

1. *Introductory Core Text* (Fundisa for Change Programme, 2013)

2. Guidelines for Facilitation of the Fundisa for Change Teacher Education Programmes (Fundisa for Change Programme, 2014)

3. *Framing Active Teaching and Learning in CAPS* (O'Donoghue, 2013)

4. *Fundisa for Change Partnership Protocol* (Rosenberg & Lotz-Sisitka, 2013)

5. Methods and Processes to Support Change-oriented Learning (Rosenberg, O'Donoghue, & Olvitt, 2013)

Teacher knowledge being developed (if relevant)			
CK	Content knowledge	AK	Assessment knowledge
Con	Knowledge of context	PK	Pedagogical knowledge
KofL	Knowledge of learners	Curr	Curricular knowledge

THEME: Fundisa for Change course objectives

Document	**Pg**	**Quote**	**Teacher knowledge being developed (if relevant)**					
Introductory Core Text	2	In this Fundisa for Change programme we will explore environmental and sustainability content that is pertinent to your particular subject area	CK					
Introductory Core Text	2	Finally, it is important to know how to extend the environmental content in your subject so that it makes a practical difference in the life of the school.	CK	Con				
Introductory Core Text	2	The Fundisa for Change programme aims to support you to prepare teachers to engage with environmental and sustainability knowledge and skills in the curriculum, so that they may contribute to building the environmentally sustainable and healthy society that is envisaged in South Africa's Constitution	CK	Con	KofL			
Introductory Core Text	4	This course therefore introduces teachers to relevant knowledge, teaching methods and assessment practices that will enable them to teach the existing environmental content in the CAPS more confidently and successfully.	CK			AK	PK	Curr
Introductory Core Text	4	It 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 the future		Con	KofL			
Introductory Core Text	4	The course develops the knowledge and skills of teachers, enabling them to make reasoned choices about their lives and their teaching	CK				PK	

Introductory Core Text	4	It encourages teachers to develop the values and ethics needed for a more just and sustainable world.		Con				
Introductory Core Text	4	The purpose of each theme-based learning unit is to develop deep subject knowledge, with support for how to teach and assess the subject knowledge.	CK			AK	PK	
Introductory Core Text	5	One thing we can do is to give children hope that together we can 'build a better world'.			KofL			
Introductory Core Text	8	The Fundisa for Change programme helps teachers and teacher educators to think about these aspects of the curriculum, and to 'bring out' expanded knowledge and understanding of these important aspects of the curriculum, as found in the subjects.	CK					Curr
Introductory Core Text	9	The Fundisa for Change programme focuses on understanding the environmental and sustainability knowledge included in various school subjects.	CK					Curr
Introductory Core Text	11	In the Fundisa for Change programme you will use subject-specific units on particular environmental topics to address the knowledge challenge.	CK					
Introductory Core Text	11	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	CK					Curr
Introductory Core Text	12	Here we are focusing on the design and implementation of quality teaching and learning processes, or what is often referred to as pedagogy or teaching methodology					PK	
Introductory Core Text	13	These processes require particular kinds of pedagogical methods and support, which may be unfamiliar to teachers, and which will therefore be developed in the Fundisa for Change programme					PK	
Introductory Core Text	13	A booklet focusing on methods and processes is a key part of the Fundisa for Change programme and should help teachers to select appropriate methods for teaching the environmental content of their CAPS subjects.					PK	Curr
Introductory Core Text	15	In the Fundisa for Change programme we will be choosing, using and reflecting on teaching methods that are most appropriate to particular subjects					PK	
Introductory Core Text	17	This part of the Fundisa for Change programme therefore supports teachers to develop the insight and skills necessary to ensure high quality and effective assessment practices				AK		

Introductory Core Text	20	In the Fundisa for Change programme we will also consider some examples of 'assessment-in-practice' to work out how to plan for and conduct assessments of environmental learning. We will focus on improving assessment practice in the context of a subject, and its particular environmental topics and content.	CK			AK		
Introductory Core Text	21	The main focus of the Fundisa for Change programme is to strengthen and improve the quality of environmental learning in the curriculum.	CK					Curr
Fundisa for Change partnership protocol	3	Fundisa for Change is a partnership-based programme founded on principles of collaboration, transformative learning and evaluative review of practice in order to build a national system of engagement to broaden and deepen capacity for environment and sustainability education in South African schools.		Con		AK	PK	
Guidelines for facilitation	1	The Fundisa for Change Programme has an explicit approach: it seeks to support teachers understanding of, and capacity for teaching environmental knowledge and concerns as found within the national curriculum Subjects, and their cognate disciplines.					PK	Curr
Guidelines for facilitation	1	a) Generic orientation to key issues such as knowledge, curriculum knowledge, environment and sustainability knowledge, pedagogical content knowledge and approaches and assessment practice.	CK			AK	PK	Curr
Guidelines for facilitation	1	b) Specific environment and sustainability content knowledge, pedagogical content knowledge and assessment practice as relevant to specific subjects and phases and grades in the South African school system.	CK	Con	KofL	AK	PK	Curr
Guidelines for facilitation	1	c) It is closely aligned and integrated with the CAPS curriculum framework and imperatives. As it is a teacher education programme, it also seeks to expand teachers' curriculum knowledge and expertise.	CK					Curr
Guidelines for facilitation	1	d) The materials and CPD framework are designed to articulate with, and to allow teachers to reflect on textbooks and their contents and use in classrooms. The materials are also designed to provide teachers with access to additional learning support materials that can support classroom practice.	CK				PK	
Guidelines for facilitation	2	• Subject Knowledge and Learning (Theory): Show improved understanding of environment and sustainability subject knowledge in the context of a specific Subject and Phase.	CK	Con				Curr

Guidelines for facilitation	2	• Pedagogical Knowledge and Learning (Practice): Show ability to use appropriate teaching methods and assessment approaches for a specified subject knowledge, skills and values	CK			AK	PK	
Guidelines for facilitation	2	• Situated Knowledge and Learning (Context): Relate subject specific environment and sustainability content knowledge broader issues and contexts	CK	Con				
Guidelines for facilitation	2	• Practical Knowledge and Experience (Work Experience): Design, develop, implement and reflectively review a lesson plan / sequence of lesson plans relevant to an environmental and sustainability content focus in a particular Subject and Phase/ Grade.	CK	Con			PK	Curr
Methods and Processes	2	The purpose of the booklet is: ■ To help us broaden the range of methods we are comfortable to use.					PK	
Methods and Processes	2	■ To encourage us to think more carefully about how we use methods, and about the assumptions we hold about learning and teaching.					PK	
Methods and Processes	2	■ To enrich our methodological frameworks so we can use our methods with greater educational intent, towards stronger learning outcomes.				AK	PK	
Methods and Processes	5	Over time, environmentalists and educators became concerned about the need to do more than simply raise awareness about issues, or provide learners with fun experiences.			KofL			
Methods and Processes	5	Using a variety of methods increases the chances of everyone learning.			KofL		PK	
Methods and Processes	5	Secondly, a variety of methods allows us to address a variety of educational purposes and outcomes.				AK	PK	
Framing Active Teaching and Learning in CAPS	4	It provides them with a simple structure to think through the learning processes associated with a content referenced curriculum.	CK					Curr
Framing Active Teaching and Learning in CAPS	4	It is therefore a framework that helps us all to think through how to approach a content rich curriculum.	CK				PK	Curr
Framing Active Teaching and Learning in CAPS	4	It can help teacher educators to orient teachers to the new curriculum and how it is constructed, but more importantly, it aims to share how we can teach well within the new curriculum framework					PK	Curr

THEME: Educational context

Document	Pg	Quote						
Introductory Core Text	2	Knowledge on its own, however, is not enough, and the creative teacher uses a wide range of methods to mediate learning.					PK	
Introductory Core Text	4	However, teaching about the environment can be challenging as the issues are complex and much environmental information is new to teachers	CK					
Introductory Core Text	6	South Africa's 12 million scholars need to be exposed to the knowledge, skills and values that are necessary to build a just and sustainable society.		Con	KofL			
Introductory Core Text	8	Diagram 1 below suggests that we start by looking at the topics that are contained in the CAPS curriculum, and then think about them through the 'lenses' of the curriculum principles, and relate them to the three pillars of ESD. This can help to develop a coherent way of understanding the environmental and sustainability oriented learning content contained in the different subjects from a national curriculum perspective.	CK				PK	Curr
Introductory Core Text	9	Research in environmental education shows that few teachers fully understand the environment and sustainability content specified in the curriculum	CK					Curr
Introductory Core Text	10	Environmental issues are generally complex, and understanding them requires an overall appreciation of a number of aspects, from personal and cultural perspectives, to scientific and technical concepts, and political and economic interests.	CK	Con				
Introductory Core Text	10	Most teachers and learners are unaccustomed to working with knowledge that is contested or incomplete.	CK				PK	
Introductory Core Text	11	Research shows that many teachers are 'under-teaching' learners.			KofL			Curr
Introductory Core Text	13	Because active environmental learning tends to respond to unique situations, there are seldom existing lesson plans and educational materials to support the learning process.		Con			PK	
Introductory Core Text	13	Teachers need to be able to encourage learners to be creative and to use imagination, so that they can think of and develop new alternatives and solutions to environmental concerns.		Con	KofL		PK	
Introductory Core Text	13	It is important to select methods that are congruent with the particular subject, and that extend the content focus in appropriate ways.	CK	Con			PK	Curr
Introductory Core Text	14	Environmental learning often requires inter-disciplinary, thematic or integrated approaches to teaching and learning.			KofL		PK	Curr

Introductory Core Text	15	The teacher needs to avoid falling into the trap of either 'indoctrinating' learners to a particular way of thinking, or of endorsing an 'anything goes' approach to life.	CK		KofL			
Introductory Core Text	15	It is therefore important for teachers to use a variety of teaching methods to expand opportunities for learning.			KofL		PK	
Introductory Core Text	18	Even though CAPS provides very structured guidance on assessment, the teacher still needs to think through assessment carefully, and to develop effective assessment strategies.				AK	PK	Curr
Introductory Core Text	20	We will focus on improving assessment practice in the context of a subject, and its particular environmental topics and content.	CK	Con		AK		Curr
Introductory Core Text	21	The CAPS documents talk about a 'healthy environment', but it is of little value to learn about a healthy environment in theory if the environment around the classroom is unhealthy.	CK	Con				Curr
Fundisa for Change partnership protocol	3	It is being seen by the Department of Basic Education as an exemplary national professional learning community with capacity to support and influence teacher professional development that is aligned with and supportive of the Subject Contents in the Curriculum and Assesssment Policy for South Africa.	CK				PK	Curr
Guidelines for facilitation	2	The focus on subject knowledge, pedagogy and assessment takes cognizance of the core of teaching practice, but does not ignore the wider framework of whole school and community engaged education processes, and the social-ecological contexts in which environmental learning takes place.	CK	Con		AK	PK	
Methods and Processes	4	Methodologies developed in particular social, institutional and historical contexts, and we often transfer them to other contexts where they might change.		Con			PK	
Methods and Processes	12	The directory illustrates only a small sample of the diversity of methods in use to support environmental learning, in a wide variety of contexts.		Con			PK	
Framing Active Teaching and Learning in CAPS	6	The Fundisa for Change programme takes a CAPS+ approach and focuses on enhancing three essential aspects of teaching: ■ Knowing your subject, ■ Improving your teaching practice, and ■ Improving your assessment practice.	CK			AK	PK	Curr
Framing Active Teaching and Learning in CAPS	12	CAPS as a swing back to content knowledge should not be at the expense of a concern for active participation in the construction of meaning.	CK				PK	

Framing Active Teaching and Learning in CAPS	26	The challenge is to work with the curriculum specifications in enabling ways that bring out ESD.	CK					Curr

THEME: Environmental and socio-ecological context

Document	Pg	Quote						
Introductory Core Text	2	The Fundisa for Change programme aims to support you to prepare teachers to engage with environmental and sustainability knowledge and skills in the curriculum, so that they may contribute to building the environmentally sustainable and healthy society that is envisaged in South Africa's Constitution.	CK	Con			PK	
Introductory Core Text	4	Like many national curricula around the world, South Africa's new Curriculum and Assessment Policy Statements (CAPS) are rich in 'environment and sustainability' content.	CK			AK		Curr
Introductory Core Text	4	The course, which is inspired by the principle of 'building quality teaching and learning' in South African schools, focuses on science, the environment, society and sustainability.	CK	Con			PK	
Introductory Core Text	5	Most people are now aware that human actions are changing the climate in unpredictable ways. Societies around the world must 'adapt' and change their practices for a 'low carbon' future.	CK	Con				
Introductory Core Text	6	In developing countries, environmental issues are closely intertwined with development issues. For hundreds of years, due to colonialism and Apartheid, the majority of South Africans were disadvantaged in terms of access to natural resources.		Con				
Introductory Core Text	6	Indeed, education is central to ensuring that citizens are not exposed to environments that are detrimental to their health or well-being, and that South Africa's natural resources are adequately protected and sustainably used so that they benefit future generations.	CK	Con				
Introductory Core Text	6	South Africa's 12 million scholars need to be exposed to the knowledge, skills and values that are necessary to build a just and sustainable society.						
Introductory Core Text	6	The South African National Curriculum in all its forms (C2005, the NCS and now CAPS) includes a principle that the curriculum should focus on the relationship between a healthy environment, human rights, social justice and inclusivity		Con				Curr

Introductory Core Text	8	... the pillars of ESD are found in all subjects. The Fundisa for Change programme helps teachers and teacher educators to think about these aspects of the curriculum, and to 'bring out' expanded knowledge and understanding of these important aspects of the curriculum, as found in the subjects.	CK	Con				Curr
Introductory Core Text	9	The Fundisa for Change programme focuses on understanding the environmental and sustainability knowledge included in various school subjects.	CK					Curr
Introductory Core Text	10	Without a sound understanding of certain core concepts and processes, it is unlikely that an environmental issue will be adequately understood. This problem can be addressed by focusing on the teaching of core concepts and processes in various subjects that provide the foundational knowledge necessary to understand a range of environmental issues and possible solutions	CK					Curr
Introductory Core Text	11	Nor is sufficient attention paid to progression, or how to build on knowledge year by year.			KofL		PK	Curr
Introductory Core Text	11	Working with all these materials will provide the starting point to explore environmental and sustainability knowledge in the CAPS, and to engage with this knowledge in schools.	CK					Curr
Introductory Core Text	13	These processes require particular kinds of pedagogical methods and support, which may be unfamiliar to teachers, and which will therefore be developed in the Fundisa for Change programme					PK	
Introductory Core Text	15	Teaching methods that encourage learners to be aware of values, and to develop and reflect on them, are important for transformative learning. Dealing with values in education is not an easy matter, however.		Con	KofL		PK	
Introductory Core Text	15	Subject-specific units will discuss the types of methods that are most suited to teaching particular environmental topics specified in the CAPS.	CK				PK	Curr
Introductory Core Text	21	Quality teaching for sustainable schools does not only involve the actual pedagogical processes in classrooms. It also involves engaging with the school environment and the school-community context, so that school-based curriculum learning resonates with and extends into the school and its context.		Con	KofL		PK	Curr

Fundisa for Change partnership protocol	3	The programme started in 2011 out of two key recommendations in the Environmental Sector Skills Plan for South Africa (Department of Environmental Affairs, 2010) and the Biodiversity Human Capital Development Strategy for South Africa (South African National Biodiversity Initiative and The Lewis foundation, 2010). Both these strategies identified the need for strengthening teachers' knowledge of new environmental content in the national school curriculum. Both recommended the establishment of and support for a national teacher education network and systems of engagement.	CK				PK	Curr
Methods and Processes	8	Increasingly, we are drawing on social learning theories, which provide explanations for how our understandings and practices are shaped as socio-cultural groups, and how we can use or design social processes which encourage collective learning and social change.	CK	Con	KofL			
Guidelines for facilitation	2	The focus on subject knowledge, pedagogy and assessment takes cognizance of the core of teaching practice, but does not ignore the wider framework of whole school and community engaged education processes, and the social-ecological contexts in which environmental learning takes place	CK	Con		AK	PK	

Appendix J Analytic Memo 4: Reflection and evaluation form

1. Written responses

Key to codes for themes

Active	Active participation	REL	Relevance to teaching
All T	All teachers should do FfC course	RELM	Relevance and modelling of strategies
AK	Assessment knowledge	RES	Resources
CK	Content knowledge	RES FfC	Resources for course
CK of M	Content knowledge of mediator	RES FfC e	Electronic resources for course
Curric S	Curricular saliency	T Learn	Teacher learning
GW	Group work	T Strat	Teaching strategies
Learners	Relevance to learners	Tbelief L	Teacher beliefs about learning
P Ass	Purpose of assessment	Time C	Time for course
Plan	Planning	Gen	General comments
Pur	Purpose of activity		

THEME: Active participation

CODE	Teacher	Data source		Responses
Active / GW	H	REF	Q9 Plan lesson	Encouraged positive participation firstly in the "Big Idea" group - and transfer chunks among group members
Active	D	REF	Q2.12 Best aspect of course faciliation	Interactive way of engagement on topics
Active	F	REF	Q2.12 Best aspect of course faciliation	The interaction and practicals
Active	I	REF	Q3.4 Describe FfC	At least it is understable, to the level of our learners, it give all the learners & participate in a lesson.
Active	J	REF	Q1b Movie as active listening	Fruitful due to the Clip. Maximum participation from those involved.
Active	F	REF	Q5 Identifying sequence of methods	Very practical, learner participation, hands on and fun.
Active	N	REF	Q2.7 Amount of information	It wasn't tiring & it kept us involved.

THEME: All teachers should do FfC course

CODE	Teacher	Data source		Responses
All T	H	REF	Q3.4 Describe FfC	It is exceptional useful - and every teacher needs to have access to Fundisa for Change
All T	J	REF	Q3.4 Describe FfC	Effective course that needs to be introduced to all educators. Workshops to be done to educate educators
All T	G	REF	Q3.5 Other comments	It could be nice if it can be introduced to all the teachers.
All T	J	REF	Q3.6 Rating of course	Effective course. Very good. Needs to be implemented and introduced to all educators.

THEME: Assessment knowledge

CODE	Teacher	Data source	Responses

AK	I	REF	Q2.13 More attention to	Teach us how deferentiate the learners according to their levels of their understanding. How to assess them (intervention how & do them)
AK		REF	Q3.1 How strongly do you agree	f) I would be able to use teaching methods to support higher order environmental learning - A(13) SA(3)/16
AK		REF	Q3.1 How strongly do you agree	g) I would be able to prepare tools for the assessment of higher order environmental learning - A(13) SA(3)/16

THEME: Content knowledge

CODE	Teacher	Data source		Responses
CK	E	REF	Q2.13 More attention to	the content and explain fully in detail.
CK	C	REF	Q1a Movie activity	It was a video which depicted realities in our everday life and how different species interact in the biodiversity
CK	F	REF	Q1a Movie activity	Gave a better understanding of what biodiversity is about.
CK	K	REF	Q1a Movie activity	The movie helped to open up an understanding of Biodiversity
CK	L	REF	Q1a Movie activity	The movie was a true reflection of a habitat that consists of the variety of living organisms and interdependency.
CK	C	REF	Q2 Build a better world	The terms were intertwined and found that there is a thin layer which separates them.
CK	E	REF	Q2 Build a better world	I was able to understand the above mentioned in relation to the environment including factors to take into consideration
CK	I	REF	Q2 Build a better world	It broadens our minds because we have to think back and differentiate the definitions.
CK	O	REF	Q2 Build a better world	Survival in a habitat. Made me aware of the plants and animals that survive in the environment and the importance of the environment to them.
CK	P	REF	Q2 Build a better world	I became able to differentiate between the words [lots more, but it is scribbled out]
CK	L	REF	Q2.4 Relevance of content	The course tells us about what is actually happening in our biodiversity
CK	A	REF	Q2.7 Amount of information	I expected her to dwell much on the content (photosynthesis and respiration) & micro-organisms (Grade 8)
CK		REF	Q3.1 How strongly do you agree	I would be able to teach environmental content beyond the CAPS curriculum in my subject - SA(4) A(11)/15

THEME: Content knowledge of mediator

CODE	Teacher	Data source		Responses
CK of M	L	REF	Q2.12 Best aspect of course faciliation	Time management, knowledgeble facilitators, modern material, future focus lessons
CK of M	M	REF	Q2.12 Best aspect of course faciliation	When Sue recognised that the Histogram was incorrect in 1 textbook and she was able to show her excellent knowledge in explanation and video
CK of M	M	REF	Q3.5 Other comments	Thank you for your knowledge, depth and incredible patience [heart] with our group

THEME: Curricular saliency / own conceptual learning

CODE	Teacher	Data source		Responses
Curric S	H	REF	Q8 Plan Big ideas	Sharing ideas/ understanding of the Big Idea. Sharing simple lessons amongst each group member.
Curric S	J	REF	Q8 Plan Big ideas	Good and it helps us to share ideas and to know how to fish

				out content for our learners
Curric S	B	REF	Q9 Plan lesson	Give me a better understanding of the concepts that needs to be present in a ecology lesson.
Curric S	D	REF	Q9 Plan lesson	I could target important ideas and build upon.
Curric S	F	REF	Q9 Plan lesson	Useful and conceptual.
Curric S	J	REF	Q2.1 Most useful	Mind maping
Curric S	N	REF	Q2.1 Most useful	Mind mapping & planning.
Curric S	M	REF	Q3.4 Describe FfC	It is essential to understand the particular form that environmental knowledge takes in different subjects eg. Life Sciences; Geog; L.O. – the need for foundational knowledge is essential
Curric S	B	REF	Q3 CAPS mindmapping	It showed the link across grades, Thus making it helpful to trace the learner's expected Prior knowledge.
Curric S	C	REF	Q3 CAPS mindmapping	One concepts developed spirally as they touch on different aspects per grade.
Curric S	E	REF	Q3 CAPS mindmapping	I was able to use core concepts and mind mapping progression.
Curric S	I	REF	Q3 CAPS mindmapping	It enables us to think outside the box not inside
Curric S	J	REF	Q3 CAPS mindmapping	The activity was so good since one could follow and see the interdependance and interactions of concepts. How concepts link each other
Curric S	K	REF	Q3 CAPS mindmapping	This was helpful in that it helped me to identify areas to tackle on CAPS first then use it.
Curric S	M	REF	Q3 CAPS mindmapping	It was mindblowing to see the progression and link across the grades. So much is over taught!
Curric S	N	REF	Q3 CAPS mindmapping	It showed us a good way for teachers to use the CAPS documents which is usually taken for granted.
Curric S	L	REF	Q5 Identifying sequence of methods	Expanding of curriculum and increasing Curiosity towards science studies
Curric S	B	REF	Q2.4 Relevance of content	It was in line with CAPS and gave me a broader understanding for the current concepts I'm dealing with in CAPS NS
Curric S	E	REF	Q2.7 Amount of information	Information was quite good for the grade level I am going to teach
Curric S		REF	Q3.1 How strongly do you agree	I can clearly see how environmental learning is part of the curriculum – SA(8) A(8)
Curric S		REF	Q3.1 How strongly do you agree	I would be able to identify and explain key concepts related to environmental learning in my subject, to a colleague – SA(4) A(12)/16

THEME: Group work (including how group work scaffolds towards individual work)

CODE	**Teacher**	**Data source**		**Responses**
GW	A	REF	Q6 Water cycle activity	Creative thinking & sharing ideas
GW	A	REF	Q7 Assess water cycle activity	Creative thinking was encouraged here and we shared our ideas
GW	C	REF	Q7 Assess water cycle activity	This was done by grps and shortcomings were exposed which opened up grey areas to be corrected.
GW	G	REF	Q8 Plan Big ideas	Good because everyone came up with his or her opinion.
GW	H	REF	Q8 Plan Big ideas	Sharing ideas/ understanding of the Big Idea. Sharing simple lessons amongst each group member.
GW	L	REF	Q8 Plan Big ideas	Promotes group work and display the fact that's two or more heads are better than one.

GW	P	REF	Q8 Plan Big ideas	It was wonderful because we had to share the different ideas which I did not understand and know.
GW	M	REF	Q8 Plan Big ideas	The participation was adequate because the material was provided. As a group we analysed it and it assisted us in understanding that section of work in depth.
GW	K	REF	Q8 Plan Big ideas	The group planning was good in that it led to ideas coming together then being perfected. It is different from individual planning where one just looks at one's ideas and develops that.
GW	M	REF	Q8 Plan Big ideas	The participation was adequate because the material was provided. As a group we analysed it and it assisted us in understanding that section of work in depth.
GW	O	REF	Q8 Plan Big ideas	This promotes team teaching as teachers plan together the same topic. Learners in different classes can be taught using the same lesson plan.
GW / scaff	G	REF	Q9 Plan lesson	It was good because you have to do your own after working with other people.
GW	J	REF	Q9 Plan lesson	Interesting especially after group discussions. Group work made things easy.
GW / scaff	K	REF	Q9 Plan lesson	Though it was individual planning the whole idea of the lesson had been discussed by the group.
GW	C	REF	Q10 Other comments	Interaction with others is very important.
GW	A	REF	Q2.12 Best aspect of course faciliation	Group planning in preparation for lesson planning
GW	I	REF	Q2.12 Best aspect of course faciliation	To group us and then we will take turns to present what we have done as a group.
GW	F	REF	Q2.13 More attention to	Discussions
GW	B	REF	Q1b Movie as active listening	Sharing ideas during the active listening process made me aware of the different interpretations to a topic, and how all the idea can be amalgamated to form a bigger picture.
GW	C	REF	Q1b Movie as active listening	After active listening we also had time to engage each other
GW	D	REF	Q1b Movie as active listening	Being able to reflect and listening to reflections gave clearer insight into the clip.
GW	K	REF	Q1b Movie as active listening	The discussion opened up the mind from the set ideas gained while watching and others came up with their views
GW	L	REF	Q1b Movie as active listening	Shapes listening skills, visual teaching and promote group discussion.
GW	A	REF	Q2 Build a better world	Good for my professional development and understanding as there were shared ideas on these terms and misconceptions were addressed.
GW	D	REF	Q2 Build a better world	Constructive activity as thoughts, ideas and misconseptions was shared and could be cleared
GW	D	REF	Q2.4 Relevance of content	I can use and apply what was shared
GW	D	REF	Q2.7 Amount of information	Enjoyed what was shared

THEME: Relevant for learners and/or classroom application

CODE	**Teacher**	**Data source**		**Responses**
Learners	I	REF	Q1a Movie activity	It allows to remember what we have watched, how we able to remember even at school we can do that so that we can test our learners of how much can they remember within a very short time

Learners	J	REF	Q1a Movie activity	Effective approach to learning. Keeps learners focused. Learners retain most of the concepts, not boring but stimulating
Learners	M	REF	Q1a Movie activity	I found it to be so useful in my introduction to Biodiversity in Grade Seven – thank you because I was able to include it in my crit lesson.
Learners	N	REF	Q1a Movie activity	I learnt than learners in class learning by seeing remembering and gathering information.
Learners	A	REF	Q1b Movie as active listening	This part encourages all learners to be actively involved (listening attentively) so as to be able to respond to questions. Very useful.
Learners	F	REF	Q1b Movie as active listening	Useful in the classroom
Learners	H	REF	Q1b Movie as active listening	It grabs learners' attention – especially if the teacher tells beforehand what they will do.
Learners	O	REF	Q1b Movie as active listening	Teachers listened attentively because they knew that questions will be asked at the end of the movie. This method is very useful with learners as well.
Learners	P	REF	Q1b Movie as active listening	Learners could relate to the movie clips when are being assessed which means that will be easy for them to answer any questions.
Learners	F	REF	Q3 CAPS mindmapping	This helps learners to understand how organisms work hand in hand with their surroundings/environment. This is good because it helps make learners aware
Learners	H	REF	Q3 CAPS mindmapping	It would also assist those learners who are very slow; thereby unpacking big words into simple embedded words.
Learners	O	REF	Q3 CAPS mindmapping	Learners can make the summary of the topic by assissting each other and write down a mind map in groups, then compare their charts by looking at important terms omitted by other groups.
Learners	N	REF	Q4 Exploring teaching methods	Varying of teaching methods keeps learners engaged & the learning environment is kept conducive & exciting which helps learners grasp concepts.
Learners	I	REF	Q5 Identifying sequence of methods	It is important to start from the known to the unknown & check how much they already know

THEME: Purpose of assessment

CODE	**Teacher**	**Data source**		**Responses**
P Ass	D	REF	Q7 Assess water cycle activity	How effective a assessment can be to track teaching and learning.
P Ass	F	REF	Q7 Assess water cycle activity	This was very useful because you get to evaluate what you are specifically looking for.
P Ass	L	REF	Q7 Assess water cycle activity	Highlights the value of assessment and Assessment techniques. Adressess cognitive levels of Assessments and positive feedback.
P Ass	M	REF	Q7 Assess water cycle activity	It was fun to have another group forced to provide feedback (constructive) It made us more accountable
P Ass	P	REF	Q7 Assess water cycle activity	It was good because it was strictly to give one mark the learners can get some other marks from giving different views
P Ass	I	REF	Q10 Other comments	At the end we do assessment & check how much they have learnt from the lesson

THEME: Planning

CODE	**Teacher**	**Data source**		**Responses**
Plan	D	REF	Q8 Plan Big ideas	How planning could guide a constructive and effective lesson.

Plan	K	REF	Q8 Plan Big ideas	The group planning was good in that it led to ideas coming together then being perfected. It is different from individual planning where one just looks at one's ideas and develops that.
Plan	O	REF	Q8 Plan Big ideas	This promotes team teaching as teachers plan together the same topic. Learners in different classes can be taught using the same lesson plan.
Plan	N	REF	Q8 Plan Big ideas	Personal development as a teacher that planning is a necessary skill as a teacher. Always be sure what you are doing as a teacher & what the learners are doing. Peer teachig is very necessary.
Plan	E	REF	Q9 Plan lesson	I was able to plan the lesson and teach it using the 5E's
Plan	A	REF	Q10 Other comments	I can plan lessons enthusiastically now.
Plan	A	REF	Q2.1 Most useful	Planning of the lesson individually because I was able to apply what I learnt from class.
Plan	C	REF	Q2.1 Most useful	Planning – focusing the level of learners I'm teaching.
Plan	E	REF	Q2.1 Most useful	the water cycle activity and big ideas sheet.
Plan	N	REF	Q2.1 Most useful	Mind mapping & planning.
Plan	A	REF	Q2.2 Least useful	The group planning – I was alone (grade 8) and others were sharing ideas.
Plan	G	REF	Q2.2 Least useful	Individual lesson plan rubric
Plan	C	REF	Q2.12 Best aspect of course faciliation	Engaging us in planning lessons and practically teaching.
Plan	N	REF	Q2.12 Best aspect of course faciliation	planning
Plan	A	REF	Q2.12 Best aspect of course faciliation	Group planning in preparation for lesson planning
Plan	L	REF	Q3 CAPS mindmapping	In depth planning lead to a constructive teaching and learning. Leson become learner centred that being teacher centred
Plan	N	REF	Q5 Identifying sequence of methods	Teachers must be well prepared all the time before a lesson
Plan	L	REF	Q2.7 Amount of information	It involves planning, Analysis, discussion and evaluation of facts of which those are learner needs.

THEME: Purpose of activity

CODE	**Teacher**	**Data source**		**Responses**
Pur	M	REF	Q1b Movie as active listening	Given the instructions first assigned to me in knowing what was expected of me
Pur	H	REF	Q4 Exploring teaching methods	That was very powerful. It would assist teachers to do their planning thoroughly – knowing what they actually aiming at.
Pur	I	REF	Q9 Plan lesson	It makes me to think carefully of what is my aim for this lesson, what do I want my learners to achieve
Pur	N	REF	Q9 Plan lesson	Always plan to achieve the lesson objectives.

THEME: Relevance to teaching

CODE	**Teacher**	**Data source**		**Responses**
REL	P	REF	Q10 Other comments	It benefited from the course because I can be able to apply what was taught to me in different ways

REL	P	REF	Q2.1 Most useful	The course is so good it could be better if all other educators to attend because it does not only focus on one subject you can apply this to other subjects
REL	O	REF	Q2.2 Least useful	The lesson on biodiversity and ecology was least useful to me as I am not teaching them. I teach grade 9.
REL	C	REF	Q2.13 More attention to	practical related activities.
REL	K	REF	Q3.4 Describe FfC	It is relevant to the communities in South Africa and identifies with their environmental issues. A relevant component for teacher development.
REL	M	REF	Q3.6 Rating of course	Excellent! Only because I have been able to use so much of what you have lectured and got feedback from the class
REL	B	REF	Q1a Movie activity	It set the foundation for the lesson. Thus conveying the lesson's expectations
REL	O	REF	Q1a Movie activity	The topic was not related to the grade I am teaching ie grade 9. I am not a Biology specialist either, all this was new to me yet very informative and useful because I will use the same method when teaching earth and beyond.
REL	B	REF	Q2 Build a better world	Cannot remember linking these definitions to environmental studies.
REL	F	REF	Q2 Build a better world	Useful in the classroom
REL	L	REF	Q2 Build a better world	Knowledge focus and familiar with Science terms. Awareness of or about real life challenges and expectations.
REL	N	REF	Q2 Build a better world	Learners must be encouraged to be familiar with meanings of words & relate these words to their day to day living in the world in order to keep our world safe.
REL	G	REF	Q3 CAPS mindmapping	It was educational and is helpful for our classrooms.
REL	P	REF	Q3 CAPS mindmapping	This was very good because it showed me that from the mind-map there are lot of other lesson that you can relate to other subjects as well.
REL	H	REF	Q2.4 Relevance of content	The content was about what we currently doing in schools. So, it was worthwhile.
REL	M	REF	Q2.4 Relevance of content	The only project for Grade Seven, according to CAPS, we chose to do Biodiversity.
REL	N	REF	Q2.4 Relevance of content	It gave me an open eye on some things we take for granted as teachers
REL	O	REF	Q2.4 Relevance of content	Although the topics were not relevant to my grade, I used the methods used and I am applying them in the grade I am teaching.
REL	C	REF	Q2.7 Amount of information	It was relevant because I was able to head and tail out of it and even related it to my actual classroom teaching.
REL	F	REF	Q2.7 Amount of information	The information was reasonable and on our level.
REL	G	REF	Q2.7 Amount of information	It is short and there is a lot to be taught so that we can teach our learners.
REL FfC		REF	Q3.1 How strongly do you agree	i) I would be able to use the Fundisa for Change materials to prepare for my teaching – U(2) SA(2) A(11)/15
REL FfC		REF	Q3.1 How strongly do you agree	I can relate what I have learnt in the Fundisa for Change course, to one or more of the subjects I teach – SA(6) A(10)/16

THEME: Relevance and modelling of strategies

CODE	**Teacher**	**Data source**		**Responses**
RELM	G	REF	Q2.12 Best aspect of course	The use of appropriate methods and approaches.

			faciliation	
RELM	J	REF	Q2.12 Best aspect of course faciliation	Video clips at it sets the pace of learning
RELM	O	REF	Q2.12 Best aspect of course faciliation	Everything done was perfectly, correct approach and methods were used

THEME: Resources

CODE	**Teacher**	**Data source**		**Responses**
RES	E	REF	Q10 Other comments	Although some aspects of resources plays a fundamental role. We couldn't apply most of lesson plan activities in real life
RES	A	REF	Q2.9 Most useful resource	Worksheets on ecology (grade 8)
RES	C	REF	Q2.9 Most useful resource	learners' activities
RES	F	REF	Q2.9 Most useful resource	Active learning & Big idea
RES	H	REF	Q2.9 Most useful resource	All the booklets
RES	I	REF	Q2.9 Most useful resource	The most about practival ad group work so that the learners can all participate in the lesson.
RES	J	REF	Q2.9 Most useful resource	Framing Active Teaching Leaving In CAPS booklet
RES	L	REF	Q2.9 Most useful resource	Video clip.
RES	M	REF	Q2.9 Most useful resource	The polluted river and the videos
RES	N	REF	Q2.9 Most useful resource	Core text
RES	O	REF	Q2.9 Most useful resource	Introductory Core Text
RES	C	REF	Q2.9 Least useful resource	N/A
RES	H	REF	Q2.9 Least useful resource	None
RES	I	REF	Q2.9 Least useful resource	N/A
RES	J	REF	Q2.9 Least useful resource	Introduction Core Text booklet
RES	L	REF	Q2.9 Least useful resource	N/A
RES	M	REF	Q2.9 Least useful resource	The 'Big Ideas'
RES	N	REF	Q2.9 Least useful resource	N/A
RES	F	REF	Q2.9 Materials improved by	More practicals and discussions
RES	E	REF	Q3.5 Other comments	Teachers need resources. Most of the schools don't have resources, hence its difficult to apply most aspects in real life situation
RES	I	REF	Q2.4 Relevance of content	Our schools do not have facilities such as labs, libraries etc.
RES		REF	Q3.1 How strongly do you agree	j) I know where to find additional teaching resources for environmental learning – D(2) U(2) SA(2) A(10)

THEME: Resources for course

CODE	Teacher	Data source		Responses
RES FfC	G	REF	Q10 Other comments	It will be nice if we can have the copies of the course so that we can share with our colleagues.
RES FfC	N	REF	Q2.9 Materials improved by	Adding pictures for teacher resources
RES FfC	E	REF	Q2.12 Best aspect of course faciliation	She used the powerpoint presentation.
RES FfC	H	REF	Q2.12 Best aspect of course faciliation	Initial video, material (resources) in the form of booklets; and Power-Point roles.
RES FfC	K	REF	Q2.12 Best aspect of course faciliation	The tracing of the one drop of water.
RES FfC	L	REF	Q2.12 Best aspect of course faciliation	Time management, knowledgeble facilitators, modern material, future focus lessons
RES FfC	O	REF	Q3.4 Describe FfC	This course empowers educators with teaching methods and strategies and provides materials.
RES FfC	H	REF	Q3.5 Other comments	If schools can be supplied with Fundisa for Change resources – to supplement textbooks

THEME: Electronic resources for course

CODE	Teacher	Data source		Responses
RES FfC e	A	REF	Q2.9 Materials improved by	Supplying us with DVD's or sent electronically
RES FfC e	L	REF	Q2.9 Materials improved by	If the clips can be made available electronically to the fundis for re-use.
RES FfC e	L	REF	Q2.13 More attention to	Sharing of resources electronically for future use.
RES FfC e	A	REF	Q3.5 Other comments	It would be better if the resources can be supplied electronically for their availability to various colleages.
RES FfC e	J	REF	Q3.5 Other comments	Use of technology makes life easy especially to recipients since they retain most of e content

THEME: Teacher learning

CODE	Teacher	Data source		Responses
T Learn	C	REF	Q6 Water cycle activity	One interdependence of these sphere's was quite interesting.
T Learn	F	REF	Q6 Water cycle activity	It was understood
T Learn	I	REF	Q6 Water cycle activity	It makes us to realise that there are different types of rocks and how water and air affected our lives
T Learn	K	REF	Q6 Water cycle activity	The idea of following a drop confused some as we are used to looking at the water cycle in general and ot a specific drop. However, it is a good way of looking at it but not for lower grades.
T Learn	M	REF	Q6 Water cycle activity	Excellent knowledge
T Learn	N	REF	Q6 Water cycle activity	Understanding on how the spheres of earth interact with each other in all possible ways
T Learn	E	REF	Q7 Assess water cycle activity	It was quite informative and it gives me a clue.
T Learn	I	REF	Q7 Assess water cycle activity	It teaches us how important is the rubric making

T Learn	F	REF	Q8 Plan Big ideas	This was very useful. I could learn from others and gain new ideas. Also, everyone had their own ideas to bring to the table and we brought it together very well.
T Learn	J	REF	Q8 Plan Big ideas	Good and it helps us to share ideas and to know how to fish out content for our learners
T Learn	M	REF	Q8 Plan Big ideas	The participation was adequate because the material was provided. As a group we analysed it and it assisted us in understanding that section of work in depth.
T Learn	N	REF	Q8 Plan Big ideas	Personal development as a teacher that planning is a necessary skill as a teacher. Always be sure what you are doing as a teacher & what the learners are doing. Peer teachig is very necessary.
T Learn	A	REF	Q9 Plan lesson	Very good. Application of knowledge.
T Learn	P	REF	Q9 Plan lesson	It made me to be confident enough not to rely from our CA's to make lesson plans.
T Learn	H	REF	Q10 Other comments	The course was excellent – and enabled me to focus more attentively
T Learn	N	REF	Q10 Other comments	The exercise/course was very informative & helps teachers to see/realize some things they take for granted.
T Learn	O	REF	Q10 Other comments	I am happy/satisfied about the comments I received from the individual lesson plan, I know now what to change when writing it.
T Learn	C	REF	Q3.4 Describe FfC	It very helpful and an eye opener to environmental issues.
T Learn	D	REF	Q3.4 Describe FfC	Foundation I strengthening, empowering and advance what is known to the unknown.
T Learn	F	REF	Q3.4 Describe FfC	Insightful
T Learn	A	REF	Q1a Movie activity	Good for sharing of ideas and addressing misconceptions
T Learn	H	REF	Q1a Movie activity	This allowed me to focus more attentively on the video.
T Learn	G	REF	Q2 Build a better world	It was also teachig us.
T Learn	A	REF	Q2.1 Most useful	Planning of the lesson individually because I was able to apply what I learnt from class.
T Learn	C	REF	Q4 Exploring teaching methods	This was quite enriching and interesting as it brought profession growth esp when emphasis of importance of plants in the biodiversity.
T Learn	E	REF	Q4 Exploring teaching methods	I was able to see different methods of teaching environment learning and how to use the environment.
T Learn	L	REF	Q4 Exploring teaching methods	Promote Good Teaching practices and improve quality of learning.
T Learn	E	REF	Q2.4 Relevance of content	I learnt a lot on how to improve and the general approach to different situations.
T Learn	P	REF	Q2.4 Relevance of content	Because it is difficult for me to teach but now I am sure I can do better with the methods that I received.
T Learn	I	REF	Q2.7 Amount of information	At least I can add to the knowledge that I have to the new one I am learning
T Learn	J	REF	Q2.7 Amount of information	I didn't feel burdened but uplifted
T Learn	K	REF	Q2.7 Amount of information	A lot of booklets given and that needed much reading though it gives background but still it was a lot.
T Learn		REF	Q3.1 How strongly do you agree	e) I am able to explain the transformative nature of environmental learning to a colleague- U(1) SA(3) A(12)/16

THEME: Teaching strategies

CODE	Teacher	Data source		Responses
T Strat	D	REF	Q6 Water cycle activity	Was enlightening to see ways in which to grab interest and explain.

T Strat	H	REF	Q6 Water cycle activity	Worthwhile strategy.
T Strat	J	REF	Q6 Water cycle activity	Very interesting, challenges and stimulates thinking. Can be so useful and it was well presented by different groups meaning effective concepts were taught
T Strat	P	REF	Q6 Water cycle activity	Selecting teaching methods for environmental learning
T Strat	J	REF	Q7 Assess water cycle activity	Waal, amazing approach. Interactions were very good due to the approach. It was able to engage learners.
T Strat	C	REF	Q8 Plan Big ideas	Quite interesting as this opened up into a variety of learners' activities.
T Strat	I	REF	Q8 Plan Big ideas	It was fun because we have to present what we discussed after that.
T Strat	N	REF	Q8 Plan Big ideas	Personal development as a teacher that planning is a necessary skill as a teacher. Always be sure what you are doing as a teacher & what the learners are doing. Peer teachig is very necessary.
T Strat	C	REF	Q9 Plan lesson	I followed all the 5e's and I think mine was the best.
T Strat	L	REF	Q9 Plan lesson	Accomodiate all levels of understanding when you plan the lesson. Involve a variety of teaching aids
T Strat	M	REF	Q9 Plan lesson	It was useful but I would have preferred to work it out with the group because the lesson/plans were too long
T Strat	D	REF	Q2.1 Most useful	The different facets to biodiversity and constructive ways in which to make lesson interesting, from and worth-while.
T Strat	K	REF	Q2.1 Most useful	The use of different media and methods to attack & do a topic.
T Strat	L	REF	Q2.1 Most useful	Use of video clips is even better because it involves many skills in one lesson
T Strat	O	REF	Q2.1 Most useful	Starting a lesson by playing a movie. Asking learners to draw mind-maps in groups and reporting back to the class.
T Strat	K	REF	Q2.13 More attention to	perfecting the lesson on the drop and giving more informatation before we start
T Strat	A	REF	Q3.4 Describe FfC	Generally good because one can use different approaches to cater for diversity in learners.
T Strat	E	REF	Q3.4 Describe FfC	Fundisa for change is quite helping teachers to implement new ideas
T Strat	O	REF	Q3.4 Describe FfC	This course empowers educators with teaching methods and strategies and provides materials.
T Strat	D	REF	Q1a Movie activity	Valuable, as it gave focus to the lesson and course layout.
T Strat	G	REF	Q1a Movie activity	It was interesting and everybody participated.
T Strat	G	REF	Q1b Movie as active listening	It was good because even if you forget you can easily remember what you saw.
T Strat	I	REF	Q1b Movie as active listening	It enables us to focus and listen with understanding
T Strat	H	REF	Q2 Build a better world	It drives the learners to use dictionaries (if allowed) – thereby developing their vocabulary or term concept building and understanding
T Strat	J	REF	Q2 Build a better world	Good activity. Engagement was good and interaction was at maximum
T Strat	M	REF	Q2 Build a better world	The LORAX Dr Seuss was super for sustainability The water cycle was brilliant especially with the links to energy flow.
T Strat	A	REF	Q4 Exploring teaching methods	This was enable me to approach each lesson differently now as there are various methods that were discussed
T Strat	D	REF	Q4 Exploring teaching methods	It gave light to different ways in which the topic could be taught
T Strat	M	REF	Q4 Exploring	There are so many strategies/categories we use in teaching

			teaching methods	but the work did fit into all the categories provided
T Strat	O	REF	Q4 Exploring teaching methods	Learning new methods of teaching the topics.
T Strat	P	REF	Q4 Exploring teaching methods	It improves the teaching methods for environmental learning. Learning other theories.
T Strat	A	REF	Q5 Identifying sequence of methods	This taught me that each learning goal needs a relevant teaching method
T Strat	C	REF	Q5 Identifying sequence of methods	Various methods were used which inco-perated the use of 5e's.
T Strat	D	REF	Q5 Identifying sequence of methods	That there are multiple ways to get to a specific target.
T Strat	E	REF	Q5 Identifying sequence of methods	I am now able to identify teaching methods and their learning goal from a description of a series of lessons on a topic
T Strat	J	REF	Q5 Identifying sequence of methods	Linking these methods to the goals was a important activity. Quires trs time to think twice before writing/teaching
T Strat	K	REF	Q5 Identifying sequence of methods	This helped a lot in that the teacher could easily home in on what was to be taught and how to deliver it. We also identified what areas needed emphasis on.
T Strat	A	REF	Q2.4 Relevance of content	Teaching practice: Gave me an opportunity to understand fully the different methods one can use for different lessons
T Strat	J	REF	Q2.4 Relevance of content	learning other approaches and being reminded of others as well.
T Strat	K	REF	Q2.4 Relevance of content	I am always open to new teaching ideas and this was one of those
T Strat / active	F	REF	Q4 Exploring teaching methods	As a teacher you get to explore different methods on intergrating Ecology in your lessons and how to make the lessons more interative using active learning.

THEME: Teacher beliefs about learning

CODE	**Teacher**	**Data source**		**Responses**
Tbelief L	N	REF	Q1b Movie as active listening	It was short and precise, it gets the participants attention which is good for teaching & learning process
Tbelief L	J	REF	Q6 Water cycle activity	Very interesting, challenges and stimulates thinking. Can be so useful and it was well presented by different groups meaning effective concepts were taught
Tbelief L	J	REF	Q10 Other comments	More video clips could have been used since concept retention is maximised by seeing things
Tbelief L	L	REF	Q10 Other comments	Learners learn better when they find information themselves than to be told. Experimentation is time consuming but a good teacher.
Tbelief L	P	REF	Q5 Identifying sequence of methods	It helps learners not to focus on one thing but also to relate other steps from the same lesson

THEME: Time for course

CODE	**Teacher**	**Data source**		**Responses**
Time C	M	REF	Q2.2 Least useful	Big Ideas' groupwork – not everyone participated so time was difficult to complete
Time C	D	REF	Q2.2 Least useful	More time on topic
Time C	H	REF	Q2.2 Least useful	Too much activities in a very short time.

Time C	G	REF	Q2.13 More attention to	Extension of the length of the course.

CODE	Teacher	Data source		Responses
WS		REF	Q3.1 How strongly do you agree	h) I can explain a link between environmental learning in the classroom and whole school development - A(13) SA(2)/15

THEME: General comments not fitting into any particular theme

CODE	Teacher	Data source		Responses
Gen	B	REF	Q6 Water cycle activity	absent
Gen	E	REF	Q6 Water cycle activity	This conept we didn't look at it or go through it
Gen	G	REF	Q6 Water cycle activity	Good
Gen	L	REF	Q6 Water cycle activity	It was a life expectancy lesson that promotes conservation, Recycling and promotion of green environment.
Gen	B	REF	Q7 Assess water cycle activity	absent
Gen	G	REF	Q7 Assess water cycle activity	It was exciting.
Gen	H	REF	Q7 Assess water cycle activity	That was excellent.
Gen	A	REF	Q8 Plan Big ideas	I worked individually, no other educators were teaching group 10 Basically it was not a group work to me.
Gen	B	REF	Q8 Plan Big ideas	absent
Gen	E	REF	Q8 Plan Big ideas	It was quite useful and challenging
Gen	B	REF	Q2.1 Most useful	The excursion to Kristenbosch evoked appreciation for the environment.
Gen	F	REF	Q2.1 Most useful	The visit to Kirstenbosh was insightful
Gen	G	REF	Q2.1 Most useful	It was wonderful was the practical.
Gen	H	REF	Q2.1 Most useful	None
Gen	I	REF	Q2.1 Most useful	the one we go to Kirstenbosch we learn about nature.
Gen	M	REF	Q2.1 Most useful	There was an excellent flow from content, practical and assessment aspects!
Gen	B	REF	Q2.2 Least useful	N/A
Gen	C	REF	Q2.2 Least useful	N/A
Gen	F	REF	Q2.2 Least useful	Nothing really.
Gen	I	REF	Q2.2 Least useful	The practical about oils, rame, vinegar etc it was
Gen	K	REF	Q2.2 Least useful	All helpful.
Gen	L	REF	Q2.2 Least useful	N/A
Gen	N	REF	Q2.2 Least useful	N/A
Gen	A	REF	Q2.13 More attention to	Individual responses rather than group, less time was given for discussion after group work.
Gen	H	REF	Q2.13 More attention to	None
Gen	O	REF	Q2.13 More attention to	none
Gen	B	REF	Q3.4 Describe FfC	Not sure
Gen	G	REF	Q3.4 Describe FfC	It is good and will be helpful for our school and community because our learners will be able to go and teach their community members.

Gen	L	REF	Q3.4 Describe FfC	Userfriendly, Content focus, Skills development, Quality Assessmet & Techniques.
Gen	N	REF	Q3.4 Describe FfC	Very good
Gen	A	REF	Q3.6 Rating of course	Good
Gen	B	REF	Q3.6 Rating of course	9 out of 10
Gen	C	REF	Q3.6 Rating of course	Highly successful
Gen	D	REF	Q3.6 Rating of course	Valueable to anyone wanting to broaden their horizon.
Gen	E	REF	Q3.6 Rating of course	six out ten
Gen	F	REF	Q3.6 Rating of course	Good
Gen	G	REF	Q3.6 Rating of course	Moderate.
Gen	H	REF	Q3.6 Rating of course	10 out of 10
Gen	I	REF	Q3.6 Rating of course	9 out of 10
Gen	K	REF	Q3.6 Rating of course	on a scale of 1-10 with 10 being the highest and 1 the least = 9
Gen	L	REF	Q3.6 Rating of course	9 out of 10
Gen	N	REF	Q3.6 Rating of course	9 out of 10
Gen	O	REF	Q3.6 Rating of course	10 over 10
Gen	E	REF	Q1a Movie activity	Equity, sustainability, Resilience, Adaptation and transformation.
Gen	E	REF	Q1b Movie as active listening	Movie – individual recall, -> shared recall and notes.
Gen	G	REF	Q4 Exploring teaching methods	Good
Gen	G	REF	Q5 Identifying sequence of methods	Good
Gen	H	REF	Q5 Identifying sequence of methods	Very light order skill – that needs to be identified.
Gen	F	REF	Q2.4 Relevance of content	Grade level.
Gen	H	REF	Q2.7 Amount of information	Everything was fine.
Gen	M	REF	Q2.7 Amount of information	It was interesting and linked up well with the visit to Kirstenbosch

2. Tick responses

Key to codes for themes

REL	Relevance to teachers needs	CK of M	Content knowledge of mediators
T Learn	Teacher learning from planning assignment	RES FfC	Resource materials for course

THEME: Relevance

Question 2.4 The content provided in this course was …

e) Very relevant to my needs as a teacher	12
f) Mostly relevant to my needs	3
g) Only sometimes relevant to my needs	1
h) Not at all relevant to my needs	0

Question 2.11 The trainer(s) used appropriate methods and approaches for working with us as teachers

Tick ONE answer.

f) Strongly agree	10
g) Agree	6
h) Disagree	0
i) Strongly disagree	0
j) Unsure	0

Question 3.2 How likely are you to apply what you have learnt, in your teaching at school?
Please tick only the statements that you feel apply to you

i) Very likely to apply it in my own teaching	13
j) Very likely to apply it in my assessments	12
k) Unlikely to apply it in my own teaching	0
l) Unlikely to apply it in my assessments	0
m) More likely to share it with a colleagues	10
n) More likely to apply it in extra-murals, rather than in the classroom	3
o) Unsure if I will apply what I have learnt	0
p) I will not be teaching at schools anymore.	0

THEME: Teacher learning from planning assignment

Question 2.14 The course assignment had two parts:
Part 1: Complete a "Big ideas sheet" as a group.
Part 2: Draw up a lesson plan individually.

You may choose more than one answer.

	Part 1	Part 2
e) Too difficult	1	0
f) Just challenging enough	4	6
g) Not really helpful in strengthening my learning	1	0
h) Contributes to my further learning	11	11

THEME: Content knowledge of mediator

Question 2.10 The trainer(s) on this course were very knowledgeable:

Tick ONE answer.

f) Strongly agree	12
g) Agree	4
h) Disagree	0
i) Strongly disagree	0
j) Unsure	0

THEME: Course materials

Question 2.8 The course materials were used effectively to support our learning on the course

Tick ONE answer.

f) Strongly agree	6
g) Agree	10
h) Disagree	0
i) Strongly disagree	0
j) Unsure	0

Question 2.9 The Fundisa for Change resources are:

Introductory Core Text booklet
Methods and Processes booklet
Framing Active Teaching and Learning in CAPS booklet

How would you rate the Fundisa for Change materials? (you may choose more than one option)

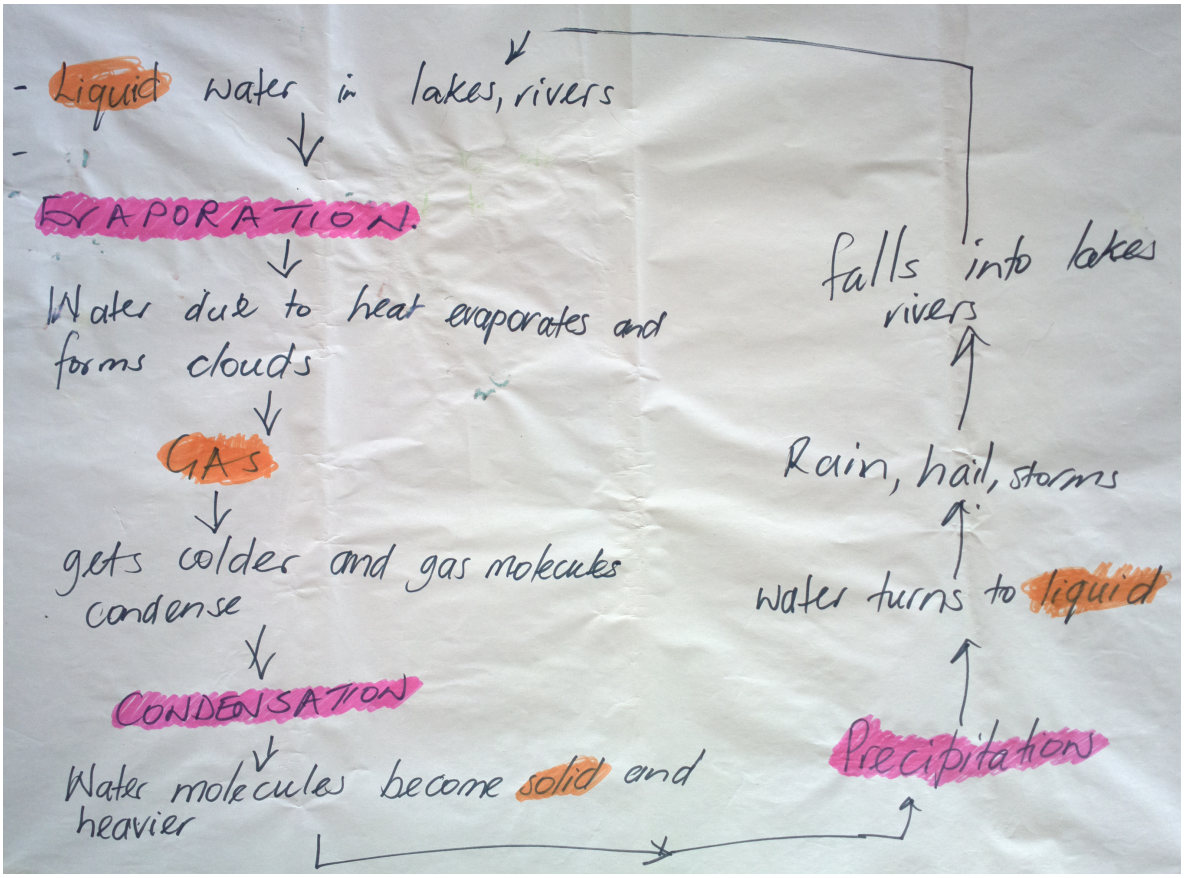
Tick ONE answer.

d) I have not given much attention to the materials so far	4
e) The materials are generally excellent	12
f) I have picked up some problems in trying to use the materials	0

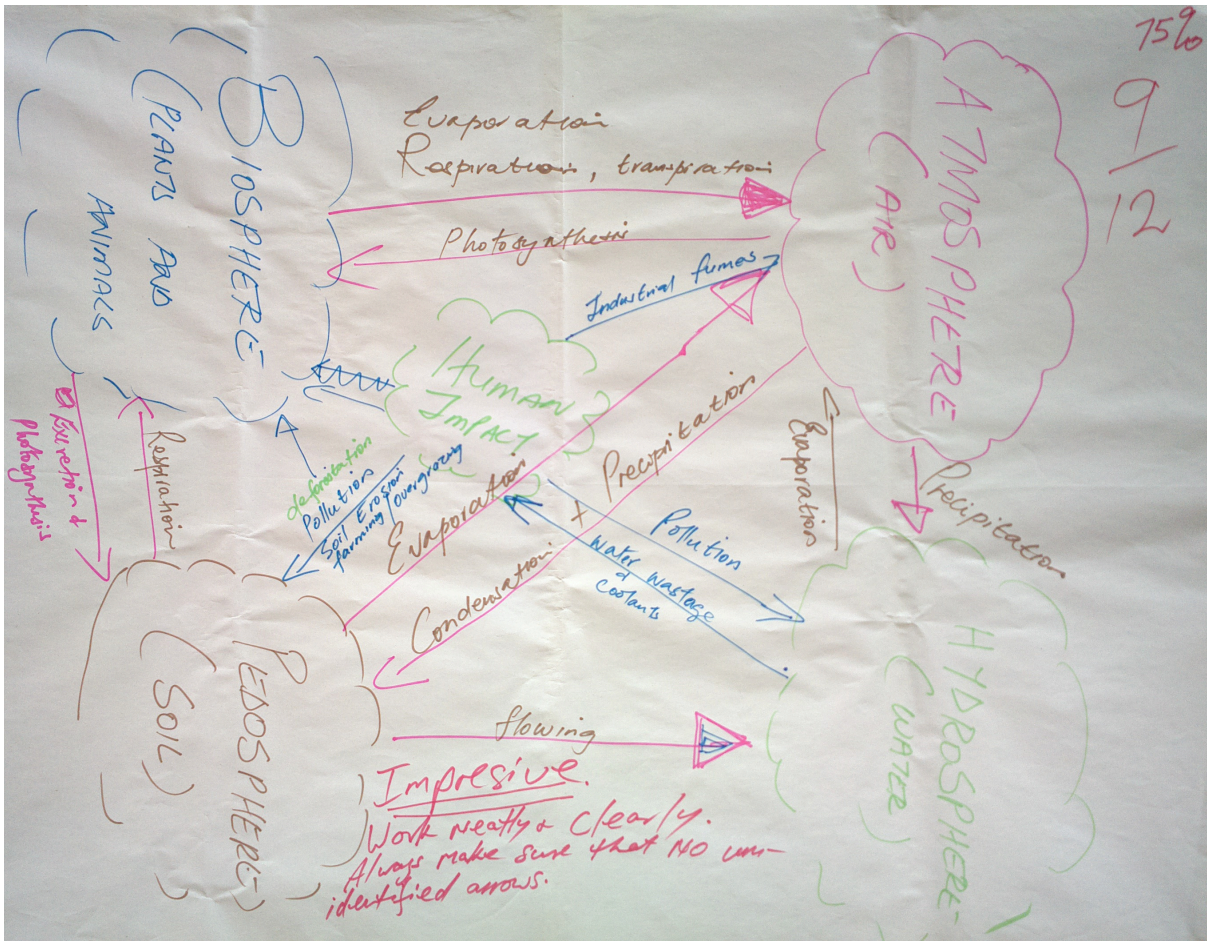
Appendix K Group outputs for Activity 6 The water cycle

Group outputs from Session 2 Activity 6 The water cycle
Groups are:
Group 1: Akhona, Lwazi, Mlondolozi, Viwe
Group 2: Phumza, Thenjiwe, Thembani, Thozama
Group 3: Fezeka, Khuthala, Daluxolo, Buzwe
Group 4: Zuko, Nomsa, Lindiwe

G1WC(1)



G1WC(2)

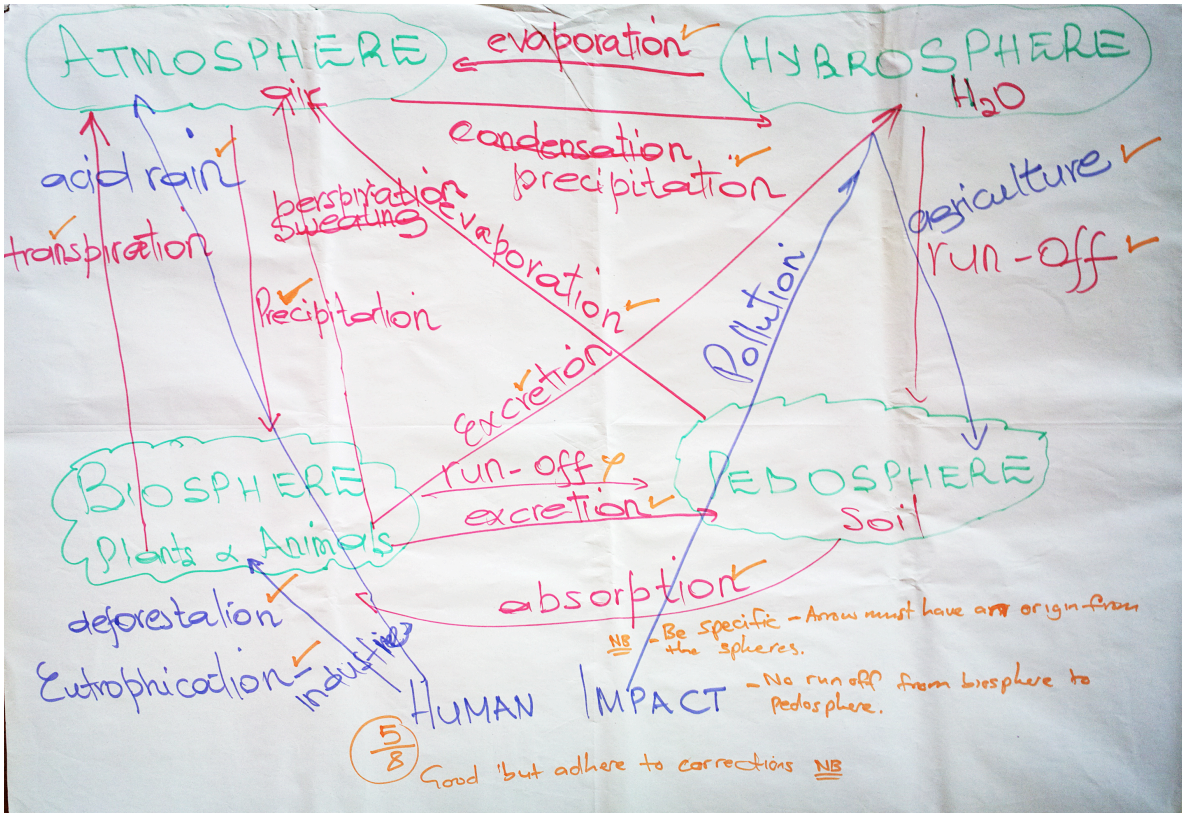

75%
9/12
BIOSPHERE
(PLANTS AND ANIMALS)
PEDOSPHERE
(SOIL)
ATMOSPHERE
(AIR)
HYDROSPHERE
(WATER)
Evaporation
Respiration, transpiration
Photosynthesis
Industrial fumes
Human Impact
deforestation
Pollution
Soil Erosion
farming overgrazing
Evaporation
Precipitation
Evaporation
Precipitation
Pollution
Water wastage
Coolants
Condensation
flowing
Impresive.
Work neatly & clearly.
Always make sure that NO un-
identified arrows.

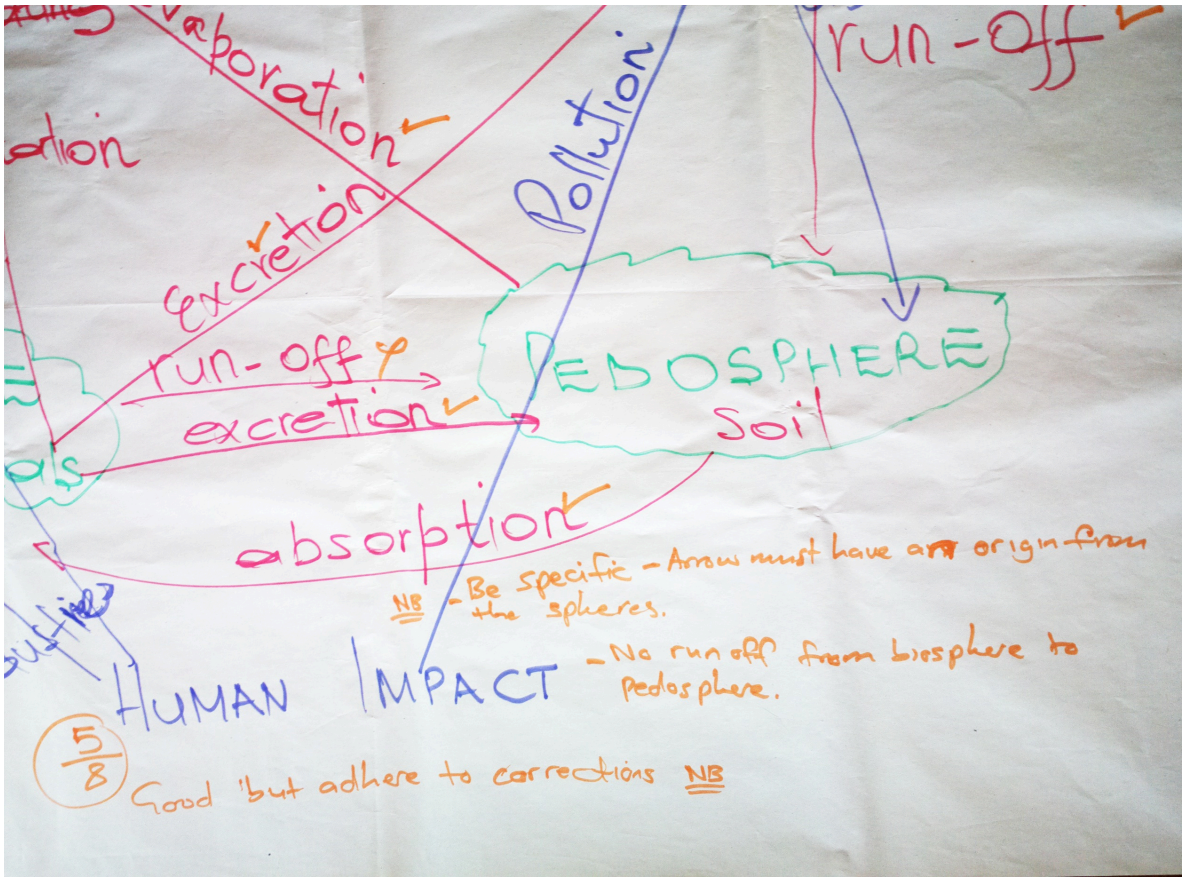
G2WC(1)

Water Cycle

- The Sun heats water in a liquid from any source e.g dams, rivers oceans, streams, etc
- Water changes from the liquid state to the gas state (water vapour) (warm air) and the process is known as evaporation.
- As the water vapour rises from its source, it comes into contact with "dirty" particles e.g. smoke which attracts water vapour to form clouds (small drops of water) • Water is changed from gas to a liquid state and that is known as condensation.
- When the drops reach a dew point, we have precipitation where rain falls. back to the oceans, rivers

G2WC(2)


ATMOSPHERE
evaporation
HYDROSPHERE
H_2O
air
condensation
precipitation
acid rain
transpiration
perspiration
sweating
evaporation
agriculture
run-off
Precipitation
excretion
Pollution
BIOSPHERE
Plants & Animals
run-off
excretion
PEDOSPHERE
Soil
deforestation
absorption
Eutrophication
industry
NB - Be specific - Arrow must have an origin from the spheres.
HUMAN IMPACT
- No run off from biosphere to Pedosphere.
5/8
Good but adhere to corrections NB

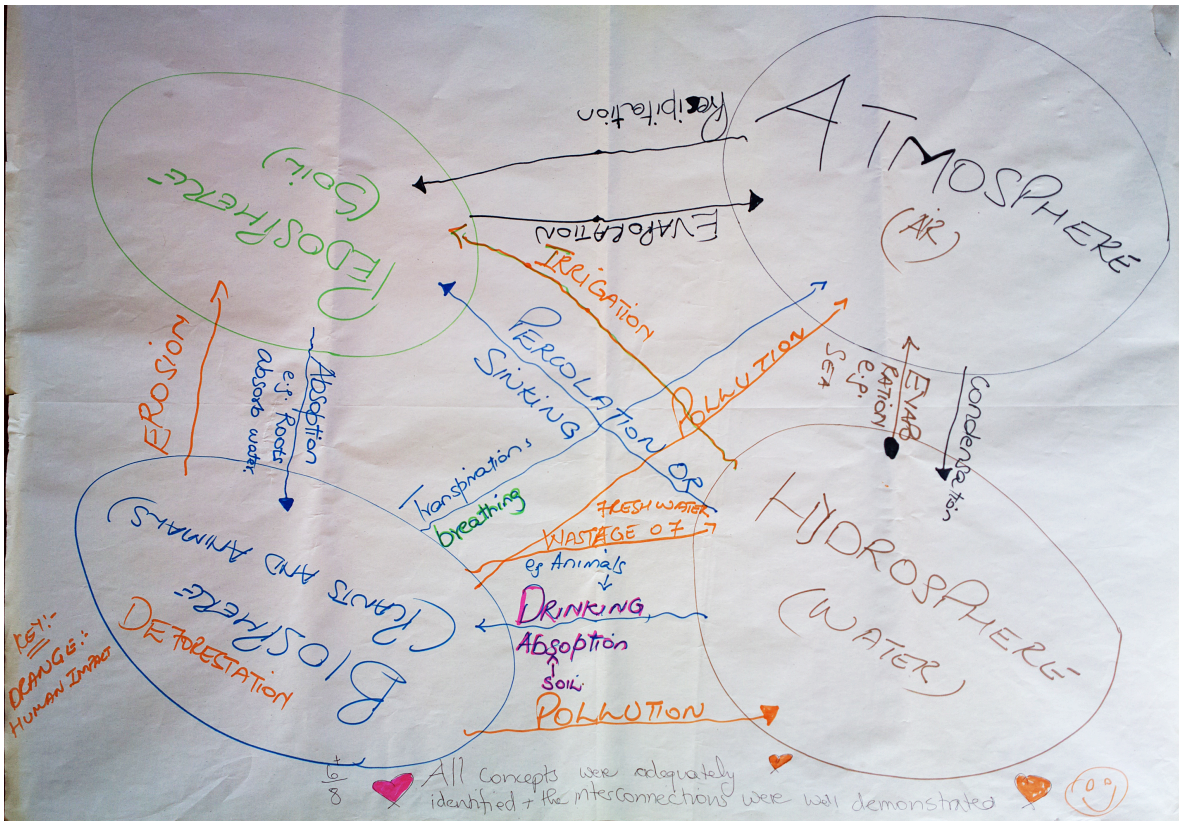

evaporation
Pollution
run-off
excretion
run-off
excretion
PEDOSPHERE
Soil
absorption
NB - Be specific - Arrow must have an origin from the spheres.
HUMAN IMPACT
- No run off from biosphere to Pedosphere.
5/8
Good but adhere to corrections NB

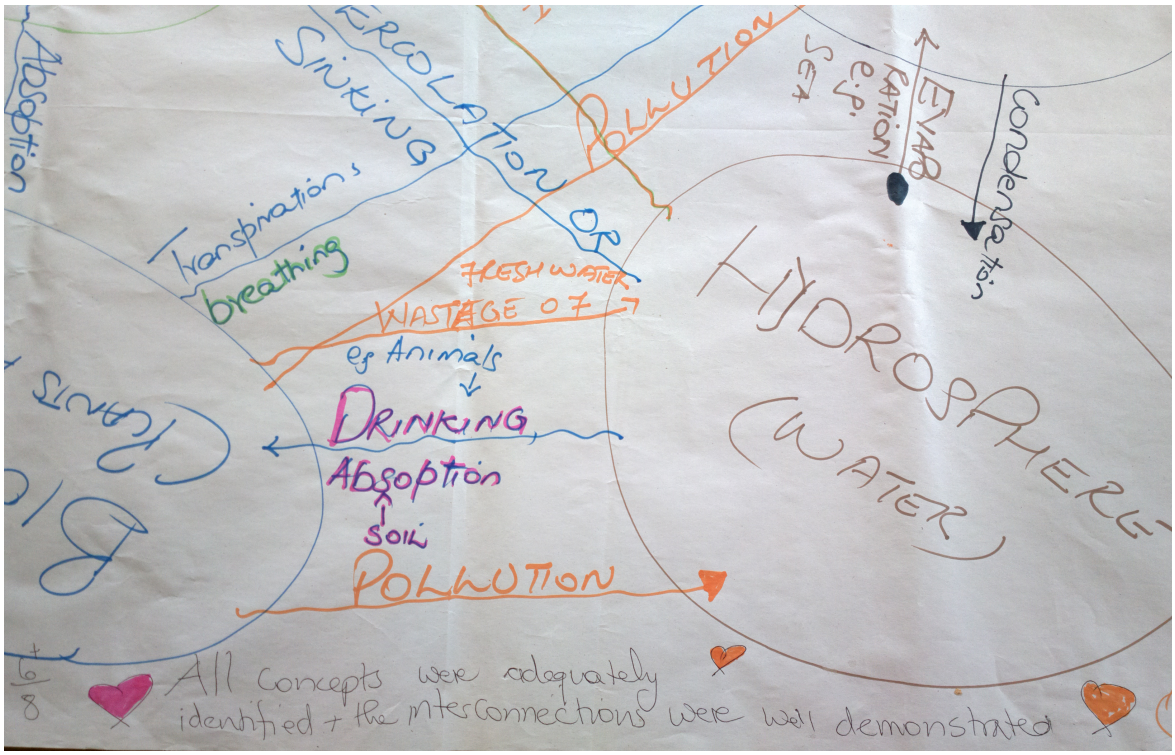
G3WC(1)

THE WATER CYCLE

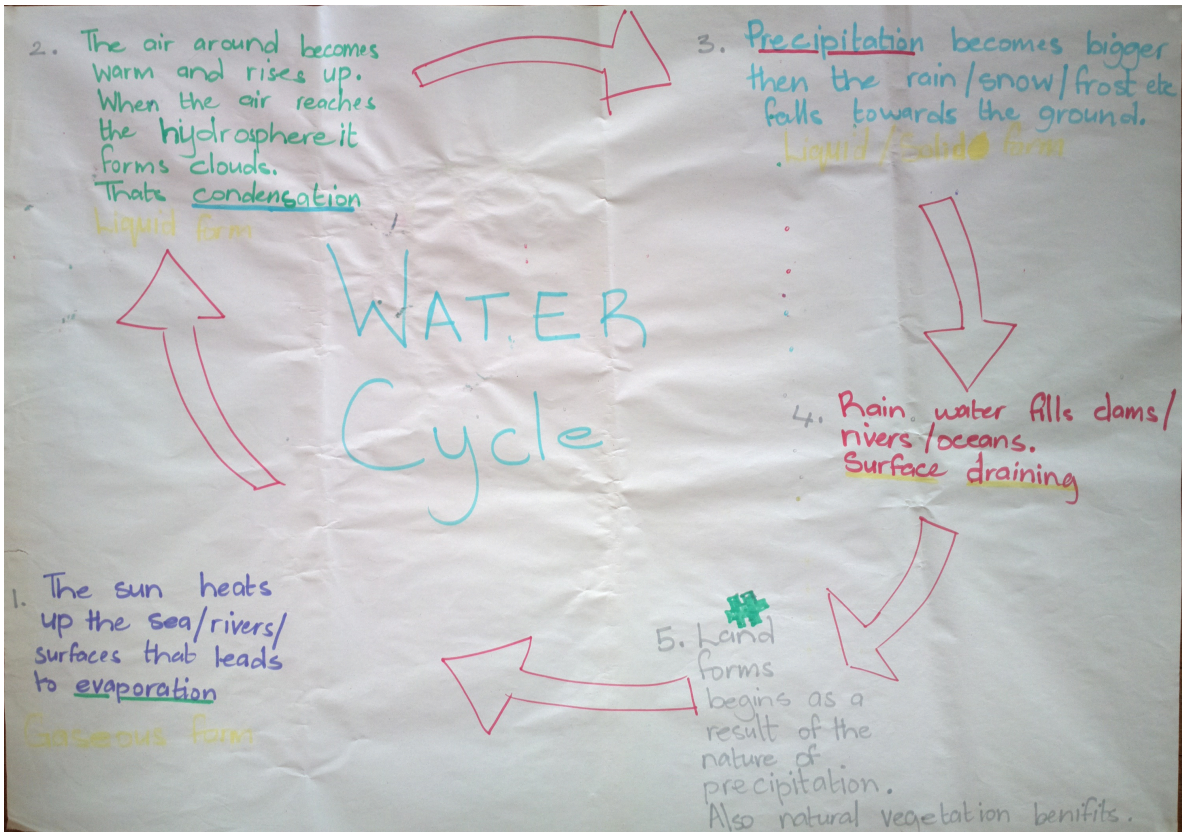
1. The sun heats the water, on water bodies and plants.
2. Water evaporates from water bodies and transpires from plants to form water vapour.
3. Water vapour rises to form the clouds.
4. The wind blows the clouds to another area.
5. The warm water vapour meets with cold air and the warm air rises and condensation takes place.
6. Precipitation takes place in the form of rain.
7. When it rains the water falls on the ground Some of the water sinks into the ground and some runs off to the [redacted] streams, rivers, lakes etc.

G3WC(2)

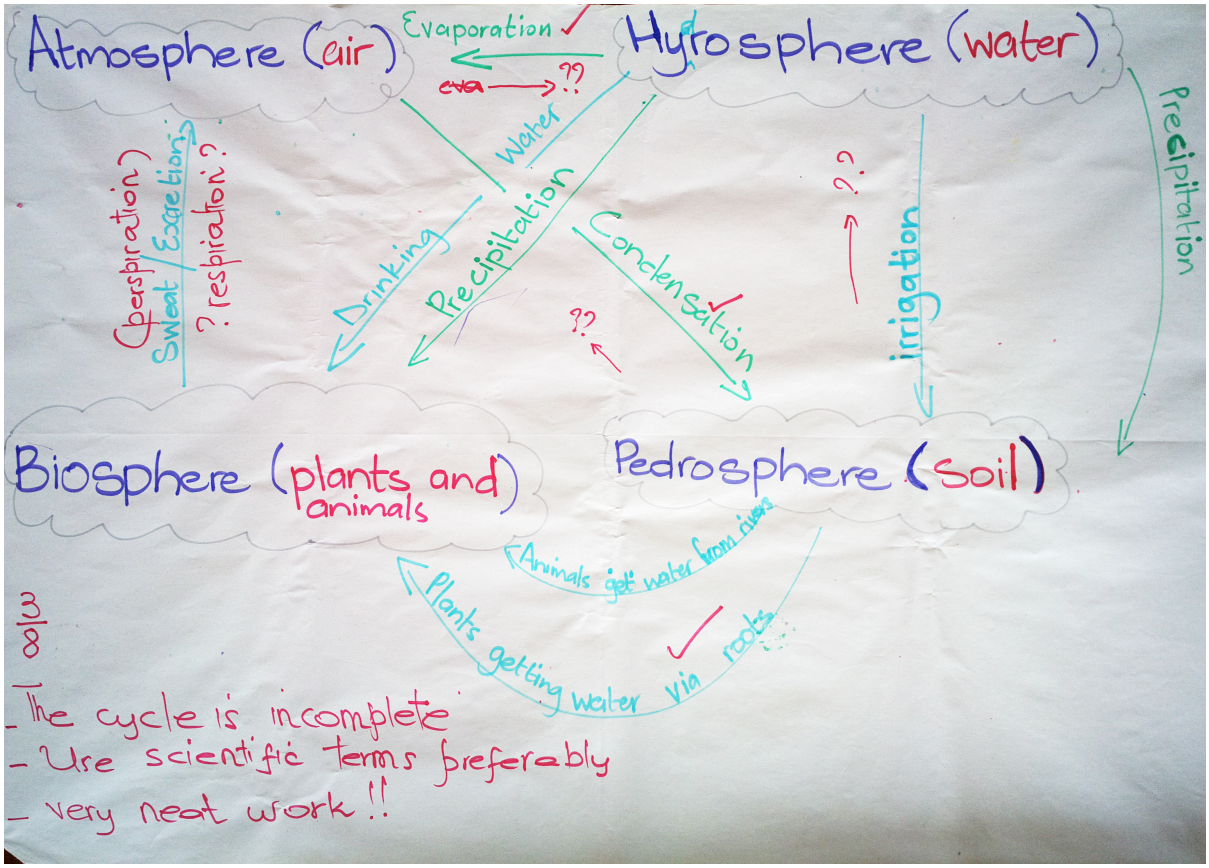

ATMOSPHERE
(AIR)
Precipitation
EVAPORATION
IRRIGATION
PERCOLATION OR
SINKING
POLLUTION
EVAPO
RATION
e.g.
SEA
Condensation
HYDROSPHERE
(WATER)
FRESH WATER
WASTAGE OF
eg Animals
DRINKING
Absoption
Soil
POLLUTION
Transpiration
breathing
EROSION
Absoption
e.g. Roots absorb water
LITHOSPHERE
(Soil)
BIOSPHERE
(PLANTS AND ANIMALS)
DEFORESTATION
KEY:-
DRAINAGE:
HUMAN IMPACT
All Concepts were adequately identified + the interconnections were well demonstrated


PERCOLATION OR
SINKING
POLLUTION
EVAPO
RATION
e.g.
SEA
Condensation
HYDROSPHERE
(WATER)
FRESH WATER
WASTAGE OF
eg Animals
DRINKING
Absoption
Soil
POLLUTION
Transpiration
breathing
Absoption
All Concepts were adequately identified + the interconnections were well demonstrated

G4WC(1)


2. The air around becomes warm and rises up. When the air reaches the hydrosphere it forms clouds. Thats condensation
Liquid form
3. Precipitation becomes bigger then the rain/snow/frost etc falls towards the ground.
Liquid/Solid form
WATER Cycle
4. Rain water fills dams/ rivers/oceans. Surface draining
1. The sun heats up the sea/rivers/ surfaces that leads to evaporation
Gaseous form
5. Land forms begins as a result of the nature of precipitation. Also natural vegetation benifits.

G4WC(2)


Atmosphere (air)
Evaporation ✓
eva → ??
Hyrosphere (water)
Precipitation
(perspiration)
Sweat / Excretion
? respiration ?
Water
Drinking
Precipitation
Condensation
??
??
irrigation
Biosphere (plants and animals)
Pedrosphere (soil)
Animals get water from rivers
Plants getting water via roots ✓
8/10
- The cycle is incomplete
- Use scientific terms preferably
- very neat work !!

Appendix L Transcribed CoRes of Grade 6 and Grade 7 groups

CoReGr6: Thembani, Sonwabo

	Big idea 1	**Big idea 2**	**Big idea 3**	**Big idea 4**
What do you intend the learners to learn about this idea?	Different Ecosystems • There are many different natural ecosystems such as rivers, mountains etc	• Living and non-living things in ecosystems. • Relationship between living and non-living things	Food Webs • In an ecosystem, plants and animals are connected by their feeding relationships.	There are different types of consumers in a food web eg herbivores, carnivores etc
Why is it important for the learners to know this?	Because it helps learners identify, classify different ecosystems	because it helps learners identify living and non-living this in ecosystems	because it helps learners describe that a food web consists of many thousands of food chains connected to each other.	because it helps learners describe that they are producers and consumers in a food web.
What else do you know about this idea that you do not intend learners to know yet?	Scientists use the word biodiversity to describe all the different living things on Earth.	No one knows exactly how many different kinds of living organisms there are on Earth.	There are different species of living organisms in a food web	Human herbivore are also called a vegan. One who don't eat and all things associated with animal products.
What difficulties/limitations are connected with teaching this idea?	Time – We cannot afford to visit all the different ecosystems at a specified period.	Time and resources is a factor. We cannot be able to explore many living and non-living.	In a whole ecosystem, the feeding relationships between plants and animals are much complex than a simple food chain	Learners struggle to distinguish between primary secondary and tertiary consumers.
What do you know about learner thinking which influences teaching about this idea?	Many students use the idea that most of our food comes from the environment	Many students cannot use the seven life processes to differentiate living and non-living.	Learners cannot differentiate a food chain from a ~~web~~ food web.	Learners struggle to explain that ~~all~~ a food chain always starts with plants (producers).
Are there any other factors that influence your teaching of this idea?	Not all students have been exposed to the environment. Some might be allergic to plants etc.	Some of them are still very young to understand some concepts taught in the abstract.	Children cannot understand and use the hands on approach to teach the food web	Learners are not exposed to different names of animals and other living things in an environment.
What teaching procedures or methods would you use, and why, for this idea?	Exploring, active learning, exercusions to different ecosystems rivers, mountains etc.	- listening with intent. - Excursions – visiting some ecosystems - Reading some case studies & Ans questions	Drawing food webs Identify some possible areas in or near school before lesson	Study the food web and identify the producers and the consumers. Describing ~~the~~ different food webs
How would you ascertain learner understanding of, or confusion about, this idea?	Describing different ecosystems. Draw a table with photographs of different ecosystems. Then write a description of the ecosystem where you identify some important features such as rivers etc	→learners give own summaries. by writing short sentences about work done → Writing & ans questions from worksheets → dramatizing or role playing.	Drawing food webs. Use the following list of organisms in a sea and forest ecosystem to draw a food web for each ecosystem. Investigate an ecosystem in or near the school.	Learners should identify and describe herbivores, carnivores, omnivores, insectivores, scavengers and decomposers.

CoReGr7: Mlondolozi, Lwazi, Phumza, Akhona

	Big idea 1 **Living organisms of the same type belong to the Same Species**	**Big idea 2** **Organisms from the same ~~type~~ species can reproduce Sexually and produce offspring that are fertile and reproduce.**	**Big idea 3** **Variation is the difference between individual from the same species**	**Big idea 4** **This variation can be inherited from one generation to the next**
What do you intend the learners to learn about this idea?	Living organisms can be classified according to charecteristics (common or shared charecteristics	All living organisms that reproduce sexually produce offspring that have huge differences from the parent.	What does it mean that we have different skin colours heights and other differences if we are all part of Homo Sapiens.	Variation amongst human can be inherited
Why is it important for the learners to know this?	In the classification system species are at the lowest specific level, so that they understand were they and other organisms belong.	To dispel the myths of cultures and to recognise that they are unique. Reproducing is the single most defining characteristic of a species	Individual of a species have characteristics to make them survive and adapt to the environment	That there are different characteristics. When someone dies they live an inheritance But in Science Parents Pass on To
What else do you know about this idea that you do not intend learners to know yet?	Interbreeding of species.	Is The limitation to come when there is interbreeding such as infertility		Some traits are traumatic for children and they Could be angry with their parents
What difficulties/limitations are connected with teaching this idea?	Cultural limitations. Huge diversity among people that you are trying to explain. Religion.	The sensitivity surrounding reproduction of the same species when learners are pregnant.	Having prior knowledge of genetics	Difficulties will be the knowledge of genetics and how detailed the environment place inheritance. These changes do not happen quickly.
What do you know about learner thinking which influences teaching about this idea?	Their thinking that it's taboo (culturaly and Religiously). Preconceive ideas from home.	They have the prior knowledge in the previous chapter of the Angiosperm and Human Reproduction.	The differences vary a lot, no two people are exactly alike	Variation are passed from parents – their are inhereted.
Are there any other factors that influence your teaching of this idea?	Time constraints, due to discussions that take place. Religious	What the learners bring to the discussions. Attitudes	Variation occurs in all living organisms, including People, animals and plants (big)	Inheretance is affected by genetics and the environment.
What teaching procedures or methods would you use, and why, for this idea?	Question the learner, understanding →Engaging (Prior knowledge). * Active learning (Discussion) * Terminology of Variation	Verbal questioning. Respect or reproduction and knowledge is power P	GRAPHS, HISTOGRAMS MEASURE AND COLLECT INFORMATION.	Bar graph. Record Results in a table. ~~Using~~ Convert information to percentation
How would you ascertain learner understanding of, or confusion about, this idea?	Activities and worksheets	Listening for Student question.	Complete and draw their own histograms by analysing their results.	Draw bar graph. Observe and Record the Information about tongue rolling.

Appendix M CoRe PCK rubric tool

Guidelines for standards for environmental PCK components (minimally adapted from Mavhunga, 2012; Mphathiwa, 2015)

PCK components	(1) Limited	(2) Basic	(3) Developing	4 (Exemplary)
Curricular saliency	Identified subordinate ideas and pre-concepts are a mix with those of other topics or no subordinates provided Sequencing no value due to mixed concepts Reasons given for importance of topic limited to general benefit of education Inaccurate content or misunderstands big idea Possible sources of confusion not identified	Not all 4 Big ideas have subordinate concepts identified however those identified are correct Sequencing can be followed however has one illogical placing of key concepts (Big Ideas) and also for the suggested pre-concepts. Reasons given for importance of topic exclude conceptual considerations such as scaffolding/sequential development of understanding for other topics in the subject. Knowledge often limited to what student s need to know Possible sources of confusion not identified	Identifies correct subordinate ideas and shows links to Big ideas with no additional explanations Provides logical sequence of concepts of some of the Big Ideas within reason Identified pre-concepts includes those used in the definition of current topic Reasons given for importance of topic include reference to conceptual scaffolding/sequential development of understanding of other topics in the subject without specifying the topics Research evident, demonstrates sound understanding of topics beyond what student s need to know Identifies possible sources of conceptual confusion at a surface level	Identifies correct subordinate ideas and explains links to Big Ideas Provides logical sequence of concepts of all the Big Ideas and pre-concepts logical within reason Identified pre-concepts include those needed in discussing the introductory definitions and those sequentially needed in the next Big Ideas of the current topic. Reasons given for importance of topic include conceptual scaffolding/sequential development of understanding for specified subsequent topics in the subject. Comprehensive, well organised knowledge of topics; foregrounds main ideas; networked examples Identifies possible sources of conceptual confusion

Learner Prior Knowledge	Not perceptive of learners needs / No identification, acknowledgement/ no consideration of learner prior knowledge	Identifies misconception on one big idea only Aware of learners needs but not able to find appropriate balance	Identifies prior knowledge on two or more big ideas Provides the basis and reasons for the consistent learners' knowledge Aware of learners needs; considers their context and diversity	Identifies prior knowledge on all big ideas Provides the basis and reasons for the consistent students' knowledge Identifies and considers diversity in students' ability, learning style, interest, developmental level and need. Confronts misconceptions/ confirms accurate understanding / Subtle understanding of student strengths and weaknesses
Representation Explicitly in CoRes	Limited to use of analogies, demos, etc.) representation with no explanation of specific links to the concepts represented	·Describes or demonstrates ways to model or illustrate a concept (analogies, demos, diagrams etc.) Use of representation without explanatory notes to make the links to the aspects of the concept being explained (For only one big idea)	Describes or demonstrates ways to model or illustrate a concept (analogies, demos, diagrams etc.) Use of representation with explanatory notes linking the two representation to the aspect(s) of the concept being explained (For more than one big idea)	Describes or demonstrates ways to model or illustrate a concept (analogies, demos, diagrams etc.) or symbolic representation Use of detailed representation to enforce a specific aspect (s) of the concept being explained

What makes topic difficult to teach	Leaves blank space; reasons not given · Identifies broad topics without specifying the actual sub-concepts that are problematic Not perceptive of learners needs / No identification, acknowledgement/ no consideration of learner misconceptions	Identifies only the contextual constraints · Identifies broad topics without specifying the actual sub-concepts that are problematic Identifies misconceptions on one big idea only	Identifies specific concepts with reasons related to specified prior knowledge of students or common misconceptions for at least one big idea	Identifies specific concepts with reasons related to prior knowledge of specified students or common misconceptions for more than one big idea
Teaching Strategies (in, about, for)	·Provides no evidence of acknowledgement of student prior knowledge and misconceptions Lacks aspects of curriculum saliency (e.g. corresponding subordinate concepts in a topic, sequencing for scaffolding learning, awareness of the background concepts needed before teaching the topic) There are few opportunities for student development; Suggested activities are largely teacher centred Justification for choice of teaching strategy not provided	Acknowledges student misconceptions with no corresponding confrontation strategy Lacks aspects of curriculum saliency ·Uses a few T/L strategies with little variation, hence limited involvement of students as students are given tasks that develop recall No justification for choice of teaching strategy	Overall, strategy workable · Considers confirmation/confrontation of student prior knowledge and/or misconceptions Considers at least one aspect related to curriculum saliency: sequencing or what not to discuss yet or emphasis of important concepts Provides justification for choice of teaching strategy but not necessarily aligned to EE There is evidence of encouraged student involvement; experiments with a variety of T/L strategies hence students given comprehension or application tasks	Overall workable strategy to teach required concept Considers confirmation/confrontation of student prior knowledge and/or common misconceptions Considers at least two aspects related to curriculum saliency: sequencing, what not to discuss yet, emphasis of important conceptual aspects, etc. Provides justification for choice of teaching strategy consistent with EE specific strategies (in, about, for the environment) Highly student centred lesson; thoughtfully selects and effectively uses a variety of T/L strategies appropriate to the content and students.

Assessment strategies	Provides no evidence of use of formative assessment strategies to establish learner prior knowledge and misconceptions Lacks aspects of curriculum saliency (e.g. corresponding subordinate concepts in a topic, sequencing for scaffolding learning, awareness of the background concepts needed before assessing the topic) Justification for choice of assessment strategy not provided	Uses few formative assessment strategies with little variation Lacks aspects of curriculum saliency No justification for choice of assessment strategy	There is evidence of use of formative assessment strategies Considers at least one aspect related to curriculum saliency: sequencing or what not to assess yet or emphasis of important concepts Provides justification for choice of assessment strategy but not necessarily aligned to EE	Thoughtfully selects and effectively uses a variety of formative assessment strategies appropriate to the content and learners. Considers at least two aspects related to curriculum saliency: sequencing, what not to assess yet, emphasis of important conceptual aspects, etc. Provides justification for choice of assessment strategy consistent with EE specific strategies (in, about, for the environment)

Appendix N Lesson plans for Grade 6 and 7 Natural Sciences

Grade 6 Topic: Ecosystems and Food webs

Lesson plan 1 (LPGr6T1): Interactions between living and non-livings things.

<table>
<tr><td><u>Key Questions</u></td><td colspan="2">Living and non-living things in an ecosystem
What is the difference between living and non- living?
Is there a balance between living and non-living things?</td></tr>
<tr><td><u>Prior Knowledge</u></td><td colspan="2">There are many different natural ecosystems such as rivers, mountains etc. Children knows the seven life processes of living things.</td></tr>
<tr><td>Resources</td><td colspan="2">Pictures of living and non- living things, collection containers, digging tools, marking tools, environment around the school (school park, school garden etc.)</td></tr>
<tr><td>Informal assessment</td><td>What is teacher doing?</td><td>What is the learner doing?</td></tr>
<tr><td>Anecdotal records, checklist, rubric
<u>Practise and apply</u>

Using data from their observations, students compile data into graphic representation of the number of plants and animals observed(independent)</td><td>Teacher clarifies purposes of task including gathering data to inform discussions about diversity and interactions within and between ecosystems.

Describe ways in which humans depend on and affect biodiversity.
Teacher observes and gives ongoing, specific feedback</td><td>Investigate the characteristics of and inter-relationships among living things.
In groups students use available tools and observe, predict and record interactions between living and non-living things including identifying the interactive roles of producers, consumers and decomposers.
Demonstrate an understanding of the importance of biodiversity within species, within an ecosystem and between ecosystems.
Upon returning to the classroom, students share observations and insights and ask questions arising from their experiences (guided)</td></tr>
<tr><td>Assessment activity
<u>Assessment strategies:</u>
observation, response, journal(teacher prepared recording device), question and answer, essay, classroom presentation</td><td colspan="2"><u>Subtask components</u>
1. In preparation for going outside teacher leads discussion about appropriate behaviours and safety precautions.
2. Teacher reviews observational strategies (e.g. defining area to explore, identifying what to look for) and tools (e.g. magnifying lenses, digging tools, and marking tools, temporary collection containers) that can be used.
<u>Grouping</u>
Whole class, Small Groups, Individuals</td></tr>
<tr><td>Extension ideas/ challenges</td><td colspan="2">In any ecosystems plants and animals are encountered by their feeding relationships. Noone knows the number of living organisms on Earth.</td></tr>
</table>

Lesson plan 2 (LPGr6T2): Food webs

<table>
<tr><td>Key Questions</td><td colspan="2">In an ecosystem plants and animals are connected by their feeding relationships</td></tr>
<tr><td>Prior Knowledge</td><td colspan="2">Learners already know that an ecosystem is a place which has living and non-living things which depend on each other for survival.</td></tr>
<tr><td>Resources</td><td colspan="2">Worksheets ; visiting a school garden ; teacher's resource file</td></tr>
<tr><td>Informal assessment</td><td>What is teacher doing?

• Explaining new words to learners- food web , primary producers , primary , secondary and tertiary consumers, decomposers.
• Explaining how arrows should be drawn in a food web
• Allocating learners into groups for role playing</td><td>What are learners doing?

Active listening

Working as a group to do role playing on animals eating and being eaten

Presenting their plays to the class

Working in pairs answering a worksheet before exchanging and revising as a class</td></tr>
<tr><td>Assessment activity</td><td colspan="2">Learners Make A Poster Of Their Own Food Web

• It must have at least 10 living things and a human being as part of the food web
• Labels must clearly show primary producers , primary , secondary and tertiary consumers, decomposers.
• The arrows must point to the correct directions .</td></tr>
<tr><td>Extension ideas/ challenges</td><td colspan="2">Learners must make real food web from what they witness in their environment .</td></tr>
</table>

Grade 7 Topic: Variation

Lesson plan 1 (LPGr7T1): Living organisms of the same type belong to the same species

<table>
<tr><td>Key Questions</td><td colspan="2">How do we classify the living organisms?
In which kingdom do humans live in?
What are the characteristics of a human?
Define the word species.</td></tr>
<tr><td>Prior Knowledge</td><td colspan="2">All living things undergo 7 life processes.
Living things have different characteristics.
Living things reproduce the same species of the same organisms.
The species is the smallest, lowest ranking taxon and it contains only the same kind of organisms that are similar to one another.
The kingdoms are divided into phyla, then into classes, family's orders, genre and species. This is called classification. Animals reproduce by giving birth to live young or by laying eggs. Human beings, dogs, cows and other mammals give birth to babies which sometimes have similar appearance</td></tr>
<tr><td>Resources</td><td colspan="2">Pictures; Textbooks; worksheets</td></tr>
<tr><td>Informal assessment</td><td>What is teacher doing?
Teaching explaining terminology of science</td><td>What is the learner doing?</td></tr>
<tr><td></td><td>• Species- can reproduce to make more individuals of the same species
• Homosapiens- humans are calledhomosapiens
• Variations- differences between organising of the same species are called variations. No two people are exactly alike
• Inherited- inheritance is passed down from parents to their children</td><td>• Looking at different pictures with different species e.g. parent species with their offspring e.g. human pictures, animals pictures and discussing about the different characteristics
• Comparing their own pictures with their parents looking at similarities and differences (taking notes to read findings to the groups e.g. long hair or small eyes of mother or father e.g. inheritance)
• Exchanging the pictures in groups each learner identifying some inherited characteristics.
• In groups learners will talk about what they parents would say about their characteristics e.g. Soft voice from grandmother etc.</td></tr>
<tr><td>Assessment activity</td><td colspan="2">Test activity formal assessment
❖ Define the following terms:
A. Species
B. Variation
C. Inherited
D. Homosapiens
❖ Describe three of your own characteristics?</td></tr>
</table>

	❖ Where do these characteristics come from? ❖ In which class do humans and dogs belong?
Extension ideas/ challenges	Learners to check their differences in their groups and write an essay according to what they have learnt about differences in animals and the pictures that they brought from home. Thinking and writing few notes of what they think they inherited from their parents e.g. Fast thinker(mother/father), intelligence(mother/father)

Lesson plan 2 (LPGr7T2):

Key Questions	1. What are the seven key life processes? 2. How would you classify living organisms? 3. Do we have differenes in the same species? 4. What variations do we find in humans?	
Prior Knowledge	Living organisms reproduce. They reproduce after their own species. Species pass on traits and characteristics to the young ones.	
Resources	CAPS document Natural Sciences Platinum Natural Sciences Grade 7 Graph paper Laptop	
Informal assessment	What is teacher doing?	What is the learner doing?
Questioning observing	-Teacher asks questions on reproduction. - teacher explains what variation is, -teacher gives information gathering task -Teacher illustrates how to tabulate information gathered Teacher demonstrates how to draw a bar graph	-Students answer questions on reproduction -Students discuss variations in species. -Students gather information on variation. -Students draw a table of results - Students draw a bar graph to represent the information
Assessment activity	Table of results Bar graph representing gathered information	
Extension ideas/ challenges	Investigate further into variations like ear lobes and draw the graph then compare the two graphs.	

Lesson plan 3 (LPGr7T3):

Key Questions	Learners will learn about inheriting characteristics from parents **The learners will learn about the differences between members of the same species (variations)** Learners will learn about height ranges and be able to measure, collect information and record the data in the form of a histogram.	
Prior Knowledge	Learners will have learnt about the importance of Classification in Grade 4 and again in Grade 7. Bar graphs are taught in the earlier grades for Mathematics, Science and Geography. It is important that Grade 7 learners know the difference between a bar graph and a histogram to record the variations.	
Resources	Avis, J et.al Platinum Natural Sciences Grade 7 (2013) Maskew Miller Longman (Pty)Ltd Cape Town http://www.cqeacademy.com/cqe-body-of-knowledge/continuous-improvement/quality-control-tools/histograms/ whiteboard and graph paper tape measure	
Informal assessment	What is teacher doing?	What is the learner doing?
	Teach the difference between a bar graph in which the values belong in separate groups. The values are plotted as bars and can be arranged in any order. A histogram is a special type of bar graph in which the bars touch because they form a continuous range of values. They have a start and an end. Demonstrate how to do a histogram correctly on the board, following the correct process.	Once the concept of a histogram is understood and the learners have observed the practical example on the board, they need to practise the new skill of plotting a histogram accurately, using the example provided by the teacher. They need to learn to measure a partner accurately using a tape measure.
Assessment	<u>Formal Assessment Activity (FAT): Variation in the classroom.</u>	

activity	(20 marks) Investigate the height of learners in the class by working in pairs and then sharing the data with the rest of the class. The learners need to record their data in a table, analyse it, evaluate and represent the data through a histogram so they can visually display their data. Answer the questions related to variations.
Extension ideas/ challenges	Time is a factor as the CAPS document indicates a week for this entire section. This lesson will take 2 hours if done carefully and methodically. Record information about tongue rolling or as an extension, discuss percentages of population

Lesson plan 4 (LPGr7T4): Variation can be inherited from one generation to the next (PTO)

Key Questions	♠ Can variation be inherited? ♠ What are the characteristic of people that are example of variables? ♠ What are the causes of variations in a population? ✓ The role of environment ✓ The role of genes and inheritance ♠ Describe some examples of variation arising from inherited and environmental factors?		
Prior Knowledge	- Defining variation: as the difference in individuals of the same species. - Living things of the same type belong to the same species. For example, humans are one species and dogs are another species. - There is a difference between species, for example, a zebra is different from a horse		
Resources	• ICT (smartboard, videos, variation PowerPoint, internet connection to show two videos) • Genes and environment cards (one set between two) • One ruler or measuring tape per group • Photographs, images from internet, books and magazines • Worksheets		
Informal assessment	**What is teacher doing?**	**What is the learner doing?**	
1. Engage (introduction) 2. Explore (learning development) 3. Explain	**Engaging:** The teacher tells learners that they are going to watch a video in which questions (given beforehand) will have to be answered individually, and answers be shared amongst the groups members. The teacher instructs learners to jot down ideas and information they remember. Stop the video randomly and ask questions based to it Video: http://www.youtube.com/watch?v=ladIQHuepJ4&feature=related **Exploring:** Now, the teacher relates the video to learners' real life experiences. In which they will look at their families (as much as this is very sensitive because others are not living with their biological parents). The teacher will instruct learners to describe their own traits that they inherited from their parents or	Questioning like: • Jot down and remember what the video was about individually • Share notes with group members • Learners will discuss the following questions: • *What was the video about?* • *Was bad behaviour completely genetic?* • *What other factors made people more likely to have good or bad behaviour?* Describe in writing, what good or bad behaviour they think they or someone in the family inherited from their parents. What are those positive or negative traits they inherited? Learners will swap their notes, and one presents the other one's inherited behaviours and traits to the group.	*7 mins* *10 mins* *10 mins*

	great grandparents. **Teacher explaining:** **Part 1** The teacher explains more about inheritance and environmental variation and demystifies all misconceptions around the topic. For example, In living organisms variation has two causes: Variation caused by our genes that we inherit from our parents is called **inherited variation.**	Learners take notes, ask questions and answer questions asked by the teacher. Learners will further discuss why they think people behave the way they do Copy title and two definitions.	*15 mins*
4. Elaborate	Variation caused by our surroundings and the things that happen to us is called **environmental variation.** **Part 2** How do we know which variations are genetic and which are environmental?	Do activity 1: Genes vs environment sort + feedback Fill in table about twin studies	*18 mins*
5. Evaluate	Draw a copy of the twins table. **Twin studies video:** http://www.youtube.com/watch?v=BTYCv1ObZrI *How will I assess and feedback learning?* *How will I celebrate success?* *How will I link this to future learning?* Table with results from twin studies.	**Learners will have to discuss and answer the following questions:** Which feature is least affected by the twins being separated? Is this feature caused by genes or the environment? Which characteristic is most strongly influenced by environment? Give two reasons non-identical twins are more similar than two strangers? Skills: measuring, drawing and interpretation of data (in the form of information, pictures and graphs) Observations	
Assessment activity	**Research inherited traits:** Some inherited traits are clearly visible like eye-colour, hair type (curly, straight) and skin colour. Here are some that you may not have known as inherited traits: *ability to roll your tongue, thumb shape (straight or bent backwards), dominant hand, earlobe attachment, hairline (widow's peak or straight), ability to spread toes.* Work in groups of 5 or 6: **1. Draw up a tally table for the above inherited traits** **2. In your groups, find out which individual have which traits and record**		

	your tally in the table **3. Summarise your data into a bar graph:** ✓ X-axis heading: inherited traits ✓ Y-axis heading: number of people ✓ Graph heading: inherited traits of the people in our group **4. Answer these questions:** a. Which were the most common traits in your group? b. Which were the least common traits in your group?
6. Extension ideas/ challenges	- There are differences within species, for example, although all zebras look very similar at first, on closer inspection, one will observe differences between them. - The variation can help the organism survive better, which means that it will be more likely to reproduce and pass on this favourable characteristic to its young - Learners can research other common variations between people such as how earlobes are attached, presence of a gap between front teeth or not, presence of a widow's peak, or hair on knuckles. They

Appendix O Comparison of *Introductory Core Text* and enacted activities

***Fundisa for Change Introductory Core Text* Activities**	**Activities in *Teaching Life & Living* enacted course**
ACTIVITY 1 (ICT, p. 3)	**ACTIVITY 1**
GREAT IDEAS FOR ENVIRONMENTAL LEARNING Do an Internet search for one of the following terms: 'Environmental Education' or 'Education for Sustainable Development'. Have a look at how much of this kind of work is going on in the world around you. Find and share an example of an interesting educational programme or resource that is relevant to your subject	**MOVIE** Short movie from TED Ed on Biodiversity **After** watching the clip: 1. **On your own**: Write down as many facts about biodiversity as you can remember. 2. **In your groups**: Now compare with others and add to your list. 3. Now talk about the role of the instructions on your own learning
Reason for not doing/adapting core text activity Core Text activity needed internet access which is not generally available. Rather Nomvuyo and I had chosen a movie from YouTube on the topic as an example of the type of resources available and modelled a way of using a movie as a teaching strategy ie. listening with intent	
ACTIVITY 2 (ICT, p. 3)	**ACTIVITY 2**
BUILDING A BETTER WORLD Equity Sustainability Resilience Adaptation Transformation Find out what each of these words mean. • Write your own definition of each word. • For each word, give an example of a social practice that expresses the meaning of the word. Explain the relevance of these words for education in general and your subject in particular.	Identical
ACTIVITY 3 (ICT, p. 5)	
DOING IT BETTER Choose an environmental issue (e.g. water, energy, waste). Look for examples of solutions that people are proposing to address this issue (search the Internet; watch YouTube videos; check the local media). • 1. Why are these actions necessary? • 2. How do these solutions differ from 'normal practice'? 3. What do they mean for the curriculum and learning in schools and classrooms?	Left out
Reason for not doing/adapting core text activity This activity needed internet access - not generally available.	
ACTIVITY 4 (ICT, p. 7)	**ACTIVITY 3**
ENVIRONMENT IN THE CAPS Go through two or more different CAPS documents. Identify the environment and sustainability content in these documents.	**Life & Living: Ecology in the CAPS: What are learners expected to know?** 1. Take the keywords list and cut it up. 2. Create a mindmap of ECOLOGY as a

• What are learners expected to know? • How does this content differ from what is included in another subject? What characterises the knowledge in each of the subjects?	theme using the Gr 8 CAPS as a starting point. 3. Now page through the CAPS documents for Gr 4 - 7 and identify the grade and subject content to track concepts as they are introduced.
Reason for not doing/adapting core text activity Nomvuyo and I felt that we needed to focus specifically on the CAPS documents for Natural Sciences over Intermediate and Senior Phase and to map progression of concepts.	
ACTIVITY 5 (ICT, p. 8)	
THE IMPORTANCE OF CORE CONCEPTS • The Earth as a system • Key life supporting processes • How ecosystems function to support the diversity of life Work with some of the knowledge resources from your tutor to better understand the three core concepts above. Explain how each of them is relevant to your subject.	Left out as an activity at this point, but came back to core concepts of "The Earth as a system" and "Key life supporting processes" with the water cycle activity in Session 2 (see Session summary in 4.2.3.2 above) that came after ICT Activity 8.
Reason for not doing/adapting core text activity Instead we related the core concepts to the mindmapping activity and made a handout for the teachers. (see Appendix K Mindmap summary of Core Concepts)	
ACTIVITY 6 (ICT, p. 10)	
EXAMPLES OF BEST PRACTICE 1. Listening with intent 2. Reading and writing to learn 3. Using numbers and mathematical concepts Reflect on how well you use the three methods above. In each case, share with a partner examples of 'best practice' from your teaching experience.	Left out
Reason for not doing/adapting core text activity We found the *Methods and Processes* booklet quite comprehensive and decided it would be too time consuming to do both the EXAMPLES OF BEST PRACTICE and EXPLORING TEACHING METHODS activities. Rather than pick out just the first three methods mentioned, we introduced all five of the methods before doing Activity 4.	
ACTIVITY 7 (ICT, p. 12)	**ACTIVITY 4**
EXPLORING TEACHING METHODS Consult the *Methods and Processes* booklet and identify those methods you use 1) most often 2) sometimes 3) hardly ever. Which of the methods that you seldom use could you use more often in your subject teaching? Explain how and why.	**Exploring teaching methods** 1. Using the summary sheet of the Methods and Processes booklet, identify those methods you see used 1) Most often 2) Sometimes 3) Hardly ever
Reason for not doing/adapting core text activity We used a summary list of the *Methods and Processes* booklet as the booklet would take too long for teachers to read in the session. The two main purposes of this activity as we understood them, were firstly, to give teachers a language with which to talk about their methods and secondly, to increase their awareness of how many methods there are.	

<table>
<tr><th>ACTIVITY 8 (ICT, p. 12)</th><th>ACTIVITY 5</th></tr>
<tr><td>EVALUATING THE SEQUENCE OF METHODS USED IN A PROGRAMME OF LEARNING

Identify and list the sequence of teaching methods used in the following example. Which methods were essential to achieving the teacher's intention of teaching the learners about water quality?

A Grade 7 Geography teacher, teaching the topic of water quality, starts the lesson with a story of a polluted river, which tells how children in the area got sick from drinking polluted water. She then goes on to ask learners to read a section in their textbooks on water quality, as well as on water pollution and its effects. She also gives them an extract from a newspaper article on a pollution spill in the local river that was reported a year before. She then asks learners to read an aerial map showing the catchment to identify the source of the pollution. Following this, she takes learners to the local river and uses water quality test kits to test the quality of the water. After this, she asks learners to write down the results of their water quality testing, and to write a proposal on how the problem can be solved.</td><td>Evaluating the sequence of methods used in a programme of learning
Complete a table to:
1. Identify and list the sequence of teaching methods used in the following example.
2. What was the goal of each method and how did it relate to achieving the teacher's intention of teaching the learners about water quality?

<u>A series of lessons given by a Grade 7 Geography teacher, teaching the topic of water quality</u>

The teacher starts the lesson with a story of a polluted river, which tells how children in the area got sick from drinking polluted water. She then goes on to ask learners to read a section in their textbooks on water quality, as well as on water pollution and its effects. She also gives them an extract from a newspaper article on a pollution spill in the local river that was reported a year before. She then asks learners to read an aerial map showing the catchment to identify the source of the pollution. Following this, she takes learners to the local river and uses water quality test kits to test the quality of the water. After this, she asks learners to write down the results of their water quality testing, and to write a proposal on how the problem can be solved.

<table>
<tr><th>Sequence</th><th>Goal or purpose</th><th>Teaching strategy</th></tr>
<tr><td>1. Story of a polluted river</td><td>Learners understand the health risks associated with polluted drinking water.</td><td>Teacher reads story
Transfer of knowledge
Listening with intent</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td colspan="2">Reason for not doing/adapting core text activity
These two activities were essentially the same with a bit of additional scaffolding in the enacted activity in the form of a table, to separate out the activities from their purpose and the strategies used.</td></tr>
<tr><td></td><td>ACTIVITY 6</td></tr>
<tr><td></td><td>Following a drop of water
Original activity at:
<u>http://www.globe.gov/documents/</u>
Links to Grade 9, Term 4 topic The Earth as a System: Spheres of the Earth
1. Think about the pathway that water takes as it follows the water cycle. Describe, step-by-step, what happens to a drop of water. Include the various forms that water takes – solid, liquid and gas.</td></tr>
</table>

	[Use the words: solid, liquid, gas, precipitation, condensation, evaporation] 2. Copy the names of these four groups of Earth system components onto a piece of paper as shown: Atmosphere (air); Hydrosphere (water) Biosphere (Plants and animals); Pedosphere (Soil) Draw arrows between the spheres and describe how water moves from one sphere to another. 3. Discuss in your group how humans use water. Now think about how you could show these human impacts on the water cycle in your diagram above. You may decide to add a new circle labelled "Human Impacts" or to add some extra arrows and descriptions.
Reason for not doing/adapting core text activity The water cycle activity in Session 2 was an adaptation of the *Introductory Core Text* Activity 5 The importance of core concepts. The resource provided in the form of an activity, developed the core concepts of "The Earth as a system" and "Key life supporting processes".	
	ACTIVITY 7
	Big ideas and lesson plan The identifying of big ideas and the design of lesson plans were completed together as the course assessment tasks. As such they were in line with the recommended assessment for the Fundisa for Change courses in that they involved planning for teaching.
	ACTIVITY 8
	Assessment discussion This activity was included to provide a baseline for the teachers' understanding of assessment and to provoke some thought about assessment.
ACTIVITY 9 (ICT, p. 17)	**ACTIVITY 10**
ASSESSMENT OF ENVIRONMENTAL LEARNING IN CAPS Consult a CAPS statement relevant to your subject / phase / grade. What assessment expectations are relevant to the environmental / sustainability content in that curriculum statement? Working from these assessment expectations, what is the MINIMUM that learners need to be taught to succeed in these assessments? It is extremely limiting to teach only to the minimum assessment requirements. What more can you teach learners in relation to the CAPS assessment section you chose to review?	**Assessment of environmental learning in CAPS** PART 1 1. Find the Assessment guidelines at the end of the Life & Living strand for your grade. 2. Use the revised Bloom's Taxonomy Tables to locate each suggested assessment within the table by allocating a knowledge and cognitive process dimension. PART 2 **ASSESSMENT OF ENVIRONMENTAL LEARNING IN CAPS** **Consult a CAPS statement relevant to your grade. What assessment expectations are relevant to the Life & Living environmental / sustainability content in CAPS?**

	Working from these assessment expectations, what is the MINIMUM that learners need to be taught to succeed in these assessments? **What more have you taught learners in relation to this CAPS assessment section?** **What cognitive level does each assessment imply? Was it taught at that cognitive level?**
Reason for not doing/adapting core text activity Nomvuyo inserted a Part 1 into the activity to provide an opportunity for teachers to develop their understanding of cognitive levels and the revised Bloom's Taxonomy Tables.	
ACTIVITY 10 (ICT, p. 17)	**ACTIVITY 9**
ASSESSMENT OF AND FOR LEARNING *"Assessment* **for** *learning" takes note of learners' needs, and is developmental. It helps learners to improve and progress by informing them of their strengths and weaknesses. When the focus of assessment is on the results of learning, assessment is referred to as "assessment of learning'. Assessment* **of** *learning usually takes place at the end of a period of work, such as a topic, term or year. Assessment of learning is typically used for promotion and certification purposes. Both assessment for learning and assessment of learning strategies should be used during the school year* (CAPS, Geography, 2011) Read through the statement from the CAPS above, and explain the difference between assessment 'of' and assessment 'for' learning. Which of these forms of assessment do you use regularly? For each category of assessment, share an example of your own 'best practice' with a colleague.	**Assessment vignettes** 1. Read the vignettes 2. In your groups, use the questions as discussion points. Teachers were given a hand-out with four vignettes on and need to complete a table by answering the following questions: 1. Is there assessment? 2. What information was gathered? 3. Who gathered the assessment information? 4. From whom? Individuals/pairs/groups/etc 5. Who used it and how?
Reason for not doing/adapting core text activity Nomvuyo and I felt that the teachers needed more exposure to different types and purposes of assessment and how assessment can be used to inform teaching, not just assess learning. The vignettes provided discussion points as well as points of conflicting ideas that could then be clarified during feedback.	
ACTIVITY 11 (ICT, p. 18)	**ACTIVITY 11**
ASSESSMENT OF DIFFERENT SUBJECTS Take a look at the guidelines for Assessment Tasks in Geography. Compare these with Assessment Tasks in Life Orientation and	Left out

Life Sciences. • How are they similar and how are they different? • How do the assessment tasks reflect the 'integrity' of the discipline? What does this mean for how teachers should assess environmental learning in different subjects?	
Reason for not doing/adapting core text activity Mostly due to time constraints. Also, there is a focus on different assessments for different subjects in that Science requires assessment of content and process skills. The process skills are particular to science.	
ACTIVITY 12 (ICT, p. 19)	**ACTIVITY 12**
WHOLE SCHOOL DEVELOPMENT Identify any local school support programmes in your area. Make a list and discuss with colleagues to see if you can add to each other's lists.	Left out
Reason for not doing/adapting core text activity Teachers were not necessarily from the same Geographical area. Taking learners on outings has become too costly and difficult to get permission for. However, we exposed teachers to locally produced materials that we came across – for example the Primary Science Project (PSP) materials.	