Understanding the effect of a professional development programme on the classroom practice of science teachers

by

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PHILOSOPHIAE DOCTOR

DECLARATION

I, Maria Catherine Kekana, the undersigned, declare that the thesis, which I hereby submit for the degree in the study field of Mathematics, Science and Technology Education at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

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SUMMARY

A case study was undertaken with the aim of exploring teachers' views on how the ACE Natural Science (NS) programme influenced their classroom practice, and assessing to what extent the envisaged outcomes of the programme were achieved. Four Grade 7 science teachers, who had completed a specific ACE NS programme, were purposefully selected to participate in the study. The data were collected using semi-structured interviews, classroom observations, and document analysis to enhance trustworthiness. The documents of the Department of Education, the ACE Service Provider, teachers, as well as learners' workbooks were analysed. Clarke and Hollingsworth's (2002) model of teacher professional development was used as the theoretical framework for this study, and a content analysis was applied to analyse the data.

The study showed an alignment between the views and practices of the teachers. The results indicate that the envisaged outcomes of the programme were achieved to satisfaction in the case of three of the teachers, as they experienced growth in their professional identity and classroom practice, while one of the teachers was reluctant to embrace new ideas. This study provided insight into how the development of professional identity enables teachers to adapt their classroom practices.

It is recommended that teachers be supported after the completion of professional development programmes. Support should include resource packs, in-school mentoring, and organised professional learning community activities. Furthermore, there is a need to address higher order questioning skills, pedagogical skills, as well as language development in future professional development programmes for science teachers.

Keywords: Teacher professional development, classroom practice, science practical activities

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LIST OF ABBREVIATIONS

ACE	Advanced Certificate in Education
ACPs	Alternative Certification Programs
ACT	Advanced Certificate in Teaching
ANA	Annual National Assessment
BEd	Bachelor of Education
CAPS	Curriculum and Assessment Policy Statements
CHE	Council on Higher Education
CPD	Continuing Professional Development
C2005	Curriculum 2005
DBE	Department of Basic Education
DoE	Department of Education
FDE	Further Diploma in Education
HDE	Higher Diploma in Education
HEIs	Higher Education Institutions
HoDs	Head of Departments
ICT	Information and Communication Technology
ILP	Inquiry Learning Partnership
InSET	In-service Education and Training
IQMS	Integrated Quality Management System
JET	Joint Education Trust
JICA	Japanese International Cooperation Agency
LiEP	Language in Education Policy
LSC	Local Systemic Change
LoLT	Language of Learning and Teaching
MSSI	Mpumalanga Secondary Science Initiative

MTI	Mathematical Thinking for Instruction
NCS	National Curriculum Statement
NCS (R-12)	National Curriculum Statement grade R to 12
NGOs	Non-governmental organisation
NPFTED	National Policy Framework on Teacher Education and Development
NQF	National Qualification Framework
NRC	National Research Council
NS	Natural Sciences
NSC	National Senior Certificate
NTA	National Teacher Audit
OBE	Outcomes Based Education
OECD	Organisation for Economic Co-operation and Development for international student assessment
PIRLS	Progress in International Reading Literacy Study
PLESME	Programme Leader Educators in Senior phase Mathematics Education
PLC	Professional Learning Communities
PD	Professional Development
REQV	Relative Equivalent Qualification Value
RDP	Reconstruction and Development Programme
RNCS	Revised National Curriculum Statement
RSA	Republic of South Africa
SAASTE	South African Association for Science and Technology Educators
S.A	South Africa
SACE	South African Council for Educators
SAQA	South African Authority Framework
SCORE	Science Community Representing Education
SPTD	Senior Primary Teachers' Diploma

TIMSS	Trends in International Mathematics and Science Study
UNESCO	United Nations Educational, Scientific and Cultural Organization
UK	United Kingdom
US	United States

CHAPTER 1 : INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

This study explored the views of science teachers on their classroom practice after completing a professional development programme. The extent to which the programme's outcomes were achieved was also investigated. A case study involving four teachers was undertaken to gain an in-depth understanding of the effect of the Advanced Certificate in Education (ACE) (Department of Education (DoE), 2000) programme on the classroom practice of Grade 7 science teachers.

Professional development programmes are implemented to assist teachers to improve their knowledge and skills (Blank & Alas, 2009; Desimone, 2009). Mayer and Lloyd (2011) explain that the desired result of teacher development is improved classroom practice that leads to enhanced learner performance. This is in line with Yoon, Duncan, Lee, Scarloss and Shapley (2007), who find that effective professional development should improve teacher knowledge and skills, enhance the classroom practice of teachers, which in turn should lead to increased learner performance.

It has been established from previous studies that not all teacher professional development programmes are effective in enhancing learner performance (Guskey, 2003; Johnson, Kahle & Fargo, 2007). Effective teacher development programmes have specific design features, namely: to focus on content, time span, collaborative, school-based, ongoing, coherent and integrated, teacher-driven and be informed by learner performance (Garet, Porter, Desimone, Birman & Yoon, 2001; Mayer & Lloyd, 2011; Penuel, Fishman, Yamaguchi & Gallagher, 2007). Teacher development programmes involving one-session workshops have been viewed as ineffective by a number of scholars (Borko, 2004; Guskey & Yoon, 2009; Lumpe, 2007; Ono & Ferreira, 2010). Penuel *et al*. (2007) argue that workshops are ineffective because teachers do not get a chance to process what they learn in these workshops before it is practiced in the classroom. However, it is acknowledged that teacher development programmes of shorter duration, like workshops, may be used effectively for other purposes. This is in agreement with Kerka (2003), who suggests that workshops could be effective in circulating information, especially when the goal is not to change teachers' conduct and practice. She conducted a study where the link between professional development programmes and learner outcomes were explored.

Different elements and indicators of classroom practice have been linked to learner performance, for instance, Wenglinsky (2002) cites understanding each learner as an individual, assessing learners, and allowing learners to work in groups as elements of classroom practice that may improve learner performance. In another study conducted by Opdenakker and Van Damme (2006), classroom management skills and a learner-centred teaching style were referred to as indicators of effective classroom practice. Kang'ahi, Indoshi, Okwah and Osodo (2012) conducted a study where they investigated learners' poor performance in the Kiswahili language. Their focus was on the link between the teaching styles of the teachers and learner performance. It was concluded that a learner-centred approach could result in the improvement of learner performance. Accordingly, it is evident from these studies that there is a link between the classroom practice of teachers and learner performance.

1.2 BACKGROUND

When Outcomes-Based Education (OBE) was first introduced in South Africa (SA), some subjects were re-packaged into Learning Areas to suit the curriculum, titled curriculum 2005 (C2005) (DoE, 2002). Some teachers were not appropriately trained to teach the new subjects referred to as Learning Areas in C2005. It thus became necessary to re-train some teachers, while others had to upgrade their qualifications to meet the expectations and demands of C2005 (Mahomed, 2009). The DoE implemented the upgrading and re-training of teachers by introducing the Advanced Certificate in Education (ACE) programme (DoE, 2000). This, amongst other qualifications, was meant to prepare teachers to meet the requirements of the new curriculum (Carnoy & Chisholm, 2008). Some teachers enrolled for the ACE programme voluntarily to enhance their competence in their respective subjects. However, others who were on Relative Equivalent Qualification Value (REQV) 13 enrolled for the ACE programme sothat they upgrade to REQV 14. Fresen and Hendrikz (2009) argued that some teachers enrolled for ACE in response to the call that for SACE registration, they were required to have 4 years training (M+4) by 2013. So, some teachers on REQV 13 utilized the opportunity to upgrade.

The ACE programme in South Africa was meant for practicing teachers to be completed over two years. They were designed in such a way that teachers were provided with an opportunity to attend residential sessions in the university. For ACE NS science programmes such an opportunity was provided for teachers to be exposed to conducting science practical work. In addition, they were expected to read the learning materials and complete the assignments by applying what was learnt at the university (Steinberg, Barclay, Inglis, Magongwa, Mayisela, Nakedi and Snell, 2003).

"There are minimum requirements for entry into ACE programme. The entry may be vertical from a three year diploma in education REQV 13 and equivalent qualification. It may also be horizontally from a PGCE (Post Graduate Certificate in Education) or Bachelor of Education (B Ed) from an NQF level 7 or 8 qualification. Practicing educators who were already in possession of a three-year college diploma were also admitted to the new level 6 ACE" (DoE, 2000, p.2). ACE in South Africa was offered by a number of Service Providers but they had to meet 10 criteria set by Higher Education Quality Committee (HEQC). These criteria included (CHE, 2006, p. 2-12):

- The unit offering the ACE has goals, objectives and forms of internal organization to support the programme;
- The programme design should reflect the necessary and enabling features for an ACE to achieve its purpose;
- The recruitment, access and selection procedures and documents are clear and accurate;
- Policy and procedures for staff appointments, promotion and development are legitimate and fair;
- The institution gives recognition to the importance of the promotion of students' learning;
- The programme is effectively coordinated;
- Assessment policies and procedures are explicit and appropriate for the programme purpose;
- There are suitable and sufficient venues;
- Student retention and throughput rates in the programme are monitored;
- Insights and recommendations arising from regular programme reviews and impact studies are used to improve the programme's design, delivery and resourcing.

Service Providers of ACE were expected to adhere to these criteria for introducing the ACE programme and when revising it.

Soon after the introduction of the ACE programme, there was a rapid increase of similar programmes so much so that the National DoE suggested that these programmes be reviewed, and replaced (DoE, 2007a; DoE, 2007b). This suggestion was echoed in the Human Science Research Council (HSRC) report on the analysis of teacher education and curriculum change in South Africa, where it was presented that ACE programmes needed to be monitored and controlled (Kruss, 2009). This was meant to protect teachers from enrolling for sub-standard ACE programmes. The ACE programme was later discontinued with the introduction of new policy, namely, 'The minimum requirements for teacher education qualifications' (Department of Higher Education and Training, 2011), which replaced the Norms and Standards for Educators policy (DoE, 2000). The new qualification in this policy, which has similar goals to those of the ACE programme, is the Advanced Certificate in Teaching (ACT), which has been instated for the "retraining or upgrading" of teachers (Department of Higher Education and Training, 2011, p.29).

Teachers have been enrolled for the ACE programme since 2003 (Steinberg, Barclay, Inglis, Magongwa, Mayisela, Nakedi & Snell, 2003). After discontinuation of the ACE programmes, teachers who aspired to upgrade or needed retraining were enrolled for the Advanced Certificate in Teaching (ACT) programme (Department of Higher Education and Training, 2014). However, there has been no research to investigate the effects of the discontinued ACE Natural Sciences (NS) programme on teachers' views and classroom practice. The link between teachers' classroom practice and learner performance was discussed earlier, accordingly, it is necessary to explore the views of science teachers on their classroom practice after completing the ACE NS programme in order to understand how the programme affected their classroom practice and to what extent the programme's outcomes were achieved.

1.3 PROBLEM STATEMENT

In general, South African learners perform poorly in mathematics and science (Buthelezi, 2012; Campbell & Crew, 2014). This poor performance is evident in South African studies such as those reported in the systemic evaluation report (DoE, 2005a). In this report, only 31% of South African learners performed above 50% in natural sciences in Grade 6. Similarly, this poor performance is also seen in international studies such as the Trends in International Mathematics and Science Study (TIMSS) 2003 (Gonzalez, Guzmán, & Jocelyn, 2004). Part of the TIMSS 1995 and 2003 results, as depicted in Table 1.1 and 1.2, show a pattern in that South Africa is listed last internationally, lagging far behind other countries in their performance (TIMSS International Study Center, 1996).

Table 1.1:The last six countries in science achievement for eighth and seventh grade participants (TIMSS international study center, 1996)

Eighth grade		***Seventh grade***	
Country	Average Score	Country	Average Score
Belgium (Fr)	471	Latvia (LSS)	435
Iran, Islamic Rep.	470	Portugal	428
Cyprus	463	Cyprus	420
Kuwait	430	Lithuania	403
Colombia	411	Colombia	387
South Africa	326	South Africa	317

Table 1.2: The last six countries in mathematics and science achievement for eighth grade participants in TIMSS 2003 (Gonzalez *et al.*, 2004).

Mathematics eighth grade		***Science eighth grade***	
Country	Average Score	Country	Average Score
(Morocco)	387	(Morocco)	396
Philippines	378	Lebanon	393
Botswana	366	Philippines	377
Saudi Arabia	332	Botswana	365
Ghana	276	Ghana	255
South Africa	264	South Africa	244

The poor performance of learners in science, which is an ongoing problem, raises concern because science is perceived as a subject that provides learners with the necessary skills to uplift the economy. The TIMSS 2011 report revealed that the mathematics and science achievements for South Africa remained low, although there was a small improvement when compared to the 2003 TIMSS results (Reddy, Prinsloo, Visser, Arends, Winnaar, Rodgers, Janse Van Rensburg, Juan, Feza & Mthethwa, 2012). The 2011 TIMSS science achievement results indicate that South Africa's performance was the poorest with a score of 332, as shown in table 1.3. This suggests that South Africa's performance is continuously inferior to that of other countries. Thus being last in science in the international tests is a concern to all stakeholders.

Table 1.3: Science achievement ninth grade participants (Reddy *et al.*, 2012, p.5)

Country	***Average Scale Score***
Botswana	404
Honduras	369
South Africa	332

Global poor learner performance has been blamed on the under preparation of teachers (Townsend & Bates, 2007). These authors further find that the teacher cannot be the only factor affecting learner performance, mentioning structural inequalities, among others, as other factors. Kerka (2003) concurs, stating that there are other factors such as teacher characteristics and learner characteristics that could affect learner performance. Kuenzi (2008) also argues that learners are underperforming in mathematics and science due to the insufficient training of teachers in these subjects.

It should be noted that South African learners' poor performance in science continues despite the number of teachers who have completed an ACE NS programme to improve their subject knowledge and skills in science. Previous research has shown that the learners of teachers who participated in a three-year professional development programme demonstrated increased achievement (Johnson *et al.*, 2007). In Johnson *et al.*'s (2007) study, which took place in the United States of America (USA), learners who were taught by teachers who were enrolled for a professional development programme were assessed and the control group was assessed as well. It was found that the learners of these teachers performed better than learners who were taught by teachers who were not enrolled for the programme. This does not, however, suggest that all teacher development programmes translate to enhanced learner performance.

As discussed in the introduction, effective teacher professional development may enhance teacher knowledge and skills to improve classroom practices with the ultimate goal of improving learner performance. Similarly, the link between learner performance and classroom practice was highlighted. Wenglinsky (2002) conducted a quantitative study to investigate the relationship between classroom practice and learner performance, and tested hypotheses concerning teacher quality. There were three hypotheses, the first being that classroom practice would have the greatest impact on learner performance, the second being that professional development would have the second largest impact, and the third hypothesis was that teacher qualifications and teaching experience would have the least impact on learner performance. All three hypotheses tested positive, but it was found that teacher classroom practice influenced learner performance more than any other factor. The findings of Wenglinsky's (2002) study underscore the link between classroom practice and learner performance. Furthermore, the literature has established that teacher professional development enhances learner performance through improving the classroom practice of teachers (Desimone, 2009; Guskey, 2002; Supovitz & Turner, 2000). Similarly, Ahmad, Jamil and Razak (2012) conclude that classroom practice affects learner performance. Consequently, it is in this regard that the science teachers' classroom practice after completing the NS ACE programme was explored, since improved classroom practice promises improved learner performance.

Ahmad *et al*. (2012, p.2) find that "teachers and their classroom practices are one of the important factors for ensuring the productive educational outcomes", which is in agreement with Townsend and Bates' (2007) findings that quality teachers and learner performance are a priority in the agenda of governments.

1.4 RATIONALE

There is an urgent need to conduct studies that may lead to improved learner performance in science because science is one of the subjects that provides learners with skills that are critical to the economy of the country (Department of Labour, 2003; Buthelezi, 2012). Hence, as already indicated in Section 1.3, the poor performance of learners in science raises a great deal of concern (Campbell & Prew, 2014). As mentioned earlier, the previous TIMSS results showed that the poor performance of learners in primary schools was partly influenced by teachers' inadequate training in science content (Gonzalez *et al.*, 2004). In support of this claim, Kruss (2009) found that the under preparation of teachers in the subject they teach impacts their classroom practices negatively. The under preparation of teachers in science is not only a South African challenge, but also a global one. In the USA, for example, the National Research Council report (2000) reveals that the problem of under prepared teachers in mathematics and science has been a challenge for many years. Moreover, Radford (1998), in his study on a model for professional development, contended that the majority of primary school teachers were not teaching reform-based science because they needed training. This aligns with Buczynski and Hansen's (2010) conclusion that in the USA, most primary school teachers are insufficiently trained to teach scientific content. Thus, it may be concluded that South Africa could have the same challenge. It is this under preparation of science teachers that may be linked to poor learner performance.

de Feiter, Vonk and Van den Akker (1995) refer to the ongoing poor performance of learners in science as a bad and unending occurrence in the quality of science education. They refer to it as a vicious cycle, and contend that the poor quality of science education is due to the small number of adequately trained science teachers who produce only a few learners that pass Grade 12 science. Consequently, a low number of those passing science in Grade 12 will follow science related specialisations and eventually, there will be a limited number of science teachers. de Feiter *et al.*'s (1995) finding is depicted in Figure 1.1.

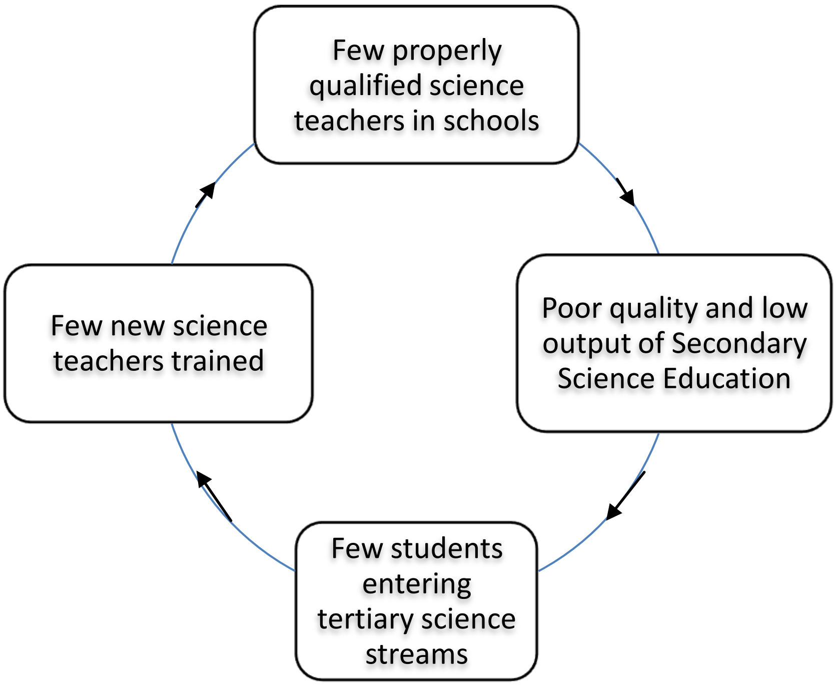


Figure 1.1: Vicious cycle in the education system of the BoLeSwa countries (de Feiter *et al.*, 1995, p.4)

De Feiter *et al.*'s (1995) study is relevant in SA still these days in view of the latest TIMSS results that show SA at the bottom. Subsequently, professional development is still relevant to break the "vicious cycle" of poor performance in science. In SA, such a vicious cycle could be managed and addressed using the current teacher education policies on professional development. The latest policy has provision for teachers who want to upgrade their qualifications or be retrained (Department of Higher Education and Training, 2011). Furthermore, there are policy frameworks in place to ensure that teachers' knowledge is enhanced. The National Policy Framework on Teacher Education and Development (NPFTED) in South Africa, among others, was designed to ensure that teachers are properly equipped to undertake their task and continually improve their professional competence (DoE, 2007b). It is according to this policy framework that teachers are expected to participate in teacher development interventions on a continuous basis to better prepare themselves in the subjects they teach. Thus, the ACE NS programme was introduced by South African Higher Education Institutions (HEIs) to implement an upgrade in service teacher education in South Africa (DoE, 2006).

Teachers used this programme to upgrade their qualifications and develop their content knowledge and skills in the subject of natural sciences. As already highlighted in Section 1.2, teachers who qualified to enroll for this programme were those whose highest qualifications were on REQV 13. These teachers were able to progress from REQV 13 to REQV 14 upon completing the programme. The ACE programme was also meant to give in-service teachers an opportunity to specialise in other subjects (DoE, 1996). It may be argued that a means of upgrading teachers similar to the ACE programme will not be necessary for the future training of teachers since the present policies are in place to ensure that students are enrolled for a 4 year degree programme for initial teacher training (DoE, 2007a ; DoE, 2007b). However, it should be noted that professional development programmes similar to the ACE-NS programme could be necessary in the future for other purposes related to teacher development. Thus, professional development programmes may always have a role to play in view of the ongoing curriculum adjustments, and to address a shortage of qualified science teachers. Consequently, many teachers enrolled for the ACE NS programme to improve their knowledge and skills. However, studies that seek to explore teachers' views and classroom practices after completing an ACE NS programme are scarce.

Guskey (2002) contends that more research is needed to establish the difference that professional development programmes is making in the classroom practice of teachers. Supovitz and Turner (2000) conducted a study where they found that there is still a need for research that will investigate the correlation between science teachers' classroom practice and learner performance. Although this study was not designed to investigate the correlation, it explored the views of science teachers of their classroom practices after completing an ACE NS programme, and probed the extent to which the envisaged outcomes were achieved. Furthermore, as an official of the DoE, the researcher has a professional interest in pursuing this study to establish what teachers think about their classroom practice after completing the ACE programme, and to what extent the outcomes of the programme have been achieved. This is necessary because the DoE has thus far spent a great amount of financial resources funding the ACE programmes in South Africa. Finally, based on new knowledge gained, this study will contribute to informing educational policy on science teacher professional development through the recommendations that will be based on the findings of the study.

1.5 AIM OF THE RESEARCH

The aim of this research was to explore science teachers' views on their classroom practice after completing an ACE programme, and to probe to what extent the outcomes of the programme have been achieved. In order to achieve this aim, an in-depth case study was undertaken, engaging four teachers who have completed an ACE NS programme at a specific South African university.

1.6 RESEARCH QUESTION

Main question

How do teachers view their classroom practice after completing an ACE programme, and to what extent have the outcomes of the programme been achieved?

Research sub questions

1. What are the outcomes envisaged by the ACE programme?
2. What does these teachers' actual classroom practice comprise?
3. What did the teachers expect to learn in the ACE programme?
4. What do teachers think they really learnt in the ACE programme?
5. How can the teachers' classroom practices be explained?

1.7 SIGNIFICANCE OF THE STUDY

There are huge financial resources invested in teacher development with the purpose of improving learner outcomes. Townsend and Bates (2007) maintain that, in the US, teacher quality and learner performance compels government to ensure that all teachers are appropriately trained. The McKinsey report (Barber & Mourshed, 2007, p.27) concluded that "the quality of an educational system cannot exceed the quality of its teachers and the only way to improve outcomes is to improve instruction". The professional development of teachers is used to enhance teacher quality. This is emphasised by Malm (2009), who finds that the quality of teachers and their teaching is an important factor that impacts learner outcomes. Furthermore, Caena (2011) states that there is a link between teacher quality and learner performance. Regardless of the enormous amount of money invested in education, education outcomes are still low (Olaniyan & Okemakinde, 2008). The ACE science programme is one of the teacher development programmes that were funded by the South African government to upgrade and retrain teachers (DoE, 2007b).

Since the ACE implementation in 2003, limited research has been conducted to explore the views of teachers on their classroom practice after completing the programme and the extent to which the outcomes of the programme have been achieved. This study was conducted in order to understand how the ACE programme has assisted science teachers to be better teachers in terms of improving their classroom practice as related to subject knowledge, practical competence, pedagogical skills, and language skills, which would ultimately enhance learner outcomes.

This study was intended to add knowledge to the area of science teacher professional development, particularly in understanding teachers' classroom practice after completing a professional development programme. It also contributes to the knowledge base in the field of creating effective professional development programmes by proposing a model of teacher development. In addition, the study may provide policy makers with insight when developing future policies related to professional development.

1.8 EXPLANATION OF CONCEPTS AS USED IN THE STUDY

The concepts used in the current study are clarified so that they may be understood in the context of the study. The concepts to be clarified are: professional development programmes, the ACE programme, classroom practice, the envisaged outcome of the ACE programme, and professional identity.

1.8.1 Professional development programmes

This is a programme designed to provide teachers with learning experience intended to enhance their classroom practice. Evans (2002, p.124) states that "the concept of teacher development is unclear" but eventually concludes that teacher development is a process of professional growth. He further explains that it is a "process involving, sequentially: the generation of ideas that may be applicable to teaching; trying out these ideas; discussing in collegial contexts the viability and implication of the ideas as they emerge as potential practice; and, adopting new practices that emanate from the ideas". He therefore regards teacher professional development as a continuous process. Glatthorn (1995, p.41) views teacher development as the "Professional growth a teacher achieves as a result of gaining increased experience and examining his or her teaching systemically". Hollingsworth (1996) argues that professional growth is a subset of professional development. The professional development programme completed by the teachers who participated in the current study refers to the ACE NS programme.

1.8.2 Advanced Certificate in Education programme

The ACE programme was a qualification for in-service teachers holding a teaching qualification who wanted to upgrade their qualification or retrain by changing their specialisation. It was meant to be completed part-time over two years and was offered by accredited Service Providers, most of which were universities in South Africa. The National Policy Framework for Teacher Education and development in South Africa stated that "The Ministry has been concerned at the undue proliferation of the ACE programme" (DoE, 2007b, p.25). This qualification was thus discontinued and has subsequently been replaced by the Advanced Certificate in Teaching (ACT) programme (Department of Higher Education and Training, 2011). In this study, the ACE programme refers to the NS ACE programme offered by the specific Service Provider selected for the study.

1.8.3 Classroom practice

It was established from the literature reviewed that classroom practice means different things to different authors, for example, Kington (2014) does not define classroom practice, but lists what an effective teacher does in the classroom. Day, Sammons and Kington (2008) maintain that classroom practice is linked to learning climate, grouping and scaffolding. On the whole, in the context of this study, science classroom practice entails the activities that the teacher carries out in the science classroom to facilitate learning. In this study, these activities are associated with teachers' subject knowledge, practical competence in conducting experiments, pedagogical skills, and language skills (see Section 2.5).

1.8.4 The envisaged outcomes of the ACE programme

The DoE's envisaged outcomes of the ACE programme were outlined in the Norms and Standards for Educators (DoE, 2000), where it was indicated that the ACE programme was meant to upgrade teachers' qualifications and retrain them. The seven roles of educators were outlined and Service Providers of ACE were required to design programmes for teachers around these seven roles (DoE, 2000). Similarly, the ACE Service Provider in this study formulated eleven goals to be achieved by teachers who were enrolled for the programme. All eleven goals were to be achieved at the end of the second and final year of the programme. In the context of this study, the envisaged outcomes of ACE refers to the seven roles of educators (DoE, 2000), as well as the eleven goals as reflected in the Service Provider's documents (Service Provider, 2013).

1.8.5 Professional identity

The literature reveals that teachers' professional identity moulds teacher learning (Beauchamp & Thomas, 2009). So, as teachers acquire knowledge in a professional development programme, their professional identity changes. It is argued that teachers' beliefs determine their actions in the classroom, and as teachers acquire knowledge, their professional identity changes (Luft & Roehrig, 2007).

For the purpose of this study, professional identity entails how science teachers perceive themselves in terms of beliefs, attitudes and knowledge after completing the ACE programme (Cheung, 2008; MacGregor, 2009). Furthermore, professional identity is discussed in the current study in the context of its relationship with the classroom practice of science teachers, and consequently learner outcomes.

1.9 LAYOUT OF THE STUDY

Chapter 1

Chapter 1 gave the introduction to the study in terms of the background, problem statement and rationale. Furthermore, the aim and the research questions for the study were outlined. This chapter discussed the significance of the study, clarified the concepts used in the research and finally, presented the layout of the study.

Chapter 2

The literature reviewed on professional development is discussed in chapter 2, where the teacher professional development programme is discussed both internationally and in the South African context. The classroom practice of teachers as well as some elements of classroom practice discussed include teachers' subject knowledge, practical competence in experiments, pedagogical skills, and language skills. The last section of chapter 2 discusses teachers' beliefs, knowledge and attitudes in the context of teacher professional identity. This is explored because a link has been found in the literature between classroom practice and teachers' knowledge, beliefs and attitudes. The gaps identified from the literature are then also discussed.

Chapter 3

This chapter focuses on the theoretical framework selected for the study. It begins with the discussion of other models related to professional development. Three models are discussed, namely, Guskey's (2002) model and Desimone's (2009) model, which are linear, as well as Clarke and Hollingsworth's (2002) model, which is cyclical. Thereafter, the application of Clarke and Hollingsworth (2002) model to this study is discussed.

Chapter 4

Chapter 4 describes the research design for the current study. This chapter explores in detail how the study was planned and conducted. The topics discussed cover: the research paradigm, sample selection, data collection, data analysis, trustworthiness of the study, and ethical considerations.

Chapter 5

Chapter 5 focuses on document analysis as one of the data collection method used in this study. The chapter begins by looking at the outcomes of the ACE programme as envisaged by the DoE, as well as the outcomes of the ACE programme from the selected Service Provider's perspective. This chapter is concluded by a comparison of the alignment of the Service Provider's Outcomes to the DoE's outcomes.

Chapter 6

Chapter 6 presents the data that has been analysed, as guided by the literature review and the theoretical framework of the study. These elements and the criteria in the instruments are used to organise the data presentation, which was prepared per case study due to the size of the data. Data from the interviews are discussed first, followed by data collected from lesson observations, and finally, data collected through an analysis of the learners' workbooks and the teachers' documents and records.

Chapter 7

This chapter concludes the study. The research question is revisited and new knowledge based on the findings is discussed. Finally, the limitations, implications and recommendations of the study are provided.

Conclusion

This chapter has introduced the study and has outlined the findings of literature as the purpose of teacher professional development. The literature has made it clear that the ultimate purpose of teacher development is to improve learner outcomes (Desimone, 2009; Guskey, 2002). Furthermore, the chapter covered the relationship between the professional development of teachers and teacher knowledge and skills, the link between teacher professional development and classroom practice, as well as the link between classroom practice and learner outcomes.

The problem identified in this study is the poor learner performance in science despite some teachers having completed a teacher development programme. The study was conducted firstly due to poor learner performance in science, which is worrisome to stakeholders (Campbell & Prew, 2014). Secondly, the literature has indicated that research on the link between teacher development and learner outcomes, teacher development and classroom practice, as well as teacher development and teachers' beliefs and attitude is scarce (Battey & Franke, 2008; Guskey, 2002; Saad & BouJaoude, 2012). Thirdly, the researcher was professionally interested in the views of teachers on their classroom practice after completing the ACE NS programme. This was also pursued due to the fact that financial resources were invested in the ACE programme. Keywords to be used in this study were clarified in the context of this study. Chapter 2 presents the literature that was reviewed for this study.

CHAPTER 2 : LITERATURE REVIEW

2.1 INTRODUCTION

The literature review presents a discussion on the purpose of professional development programmes, international and national studies, classroom practice, as well as the professional identity of teachers in terms of teachers' beliefs, knowledge and attitudes. The gaps in the literature review are also identified.

2.2 THE PURPOSE OF PROFESSIONAL DEVELOPMENT PROGRAMMES

Guskey's (2002) model of teacher development depicts three main goals of teacher professional development, namely, to change teachers' classroom practice, teachers' beliefs and attitudes, as well as learner outcomes. Furthermore, Guskey (2002) defines the professional development of teachers as a planned and purposeful means to improve their knowledge and skills. This definition eliminates unplanned means of improving teacher knowledge and skills. I argue that reading journals or books arbitrarily according to Guskey's (2002) definition might not constitute professional development. Fishman, Marx, Best and Tal (2003) suggest that teacher professional development should be basically about teacher learning. They argue that teacher learning can only happen once knowledge, beliefs and attitudes have been changed. Clearly, they believe teachers learn from a professional development after their knowledge, beliefs and attitudes have been altered. Mukeredzi (2013) conducted a study on professional development to investigate if unqualified teachers realised what they had learnt from their teaching roles and how this realisation contributed to their professional development, and concluded that teacher development is critical to the improvement of education quality, provided that it is regularly conducted and well planned.

Professional development programmes are necessary in providing teachers with the opportunity to learn on a continuous basis in view of curriculum policy changes in schools. Danielson (2009) concludes that teachers' desire to learn does not indicate that they have a deficiency. However, she argues that this desire signals a decision to improve and to be better teachers, as there will constantly be "new ideas" in the teaching profession that require teachers to improve their instruction (Danielson, 2009, p.3). Also, the revision of the curriculum is accompanied by "new ideas" that requires professional development. Furthermore, in another study, Danielson claims that teachers' continual desire to learn indicates that "teaching is so complex that it is never done perfectly; every educator can always become more skilled, more expert" (Danielson, 2008, p.17). Moreover, she suggests that teachers should not view ongoing learning as additional task, but rather as a vital part of their work. Thus the engagement and enrolment of teachers in any form of professional development programme may not only be to address their gaps in content knowledge, but also for continuing improvement. Additionally, it could be that teachers enrol for teacher development programmes because of an awareness that they are lifelong learners. The literature reveals that in the USA, professional development programmes are used to also assist teachers in aligning their teaching to the national standards (Banilower, Heck & Weiss, 2007; Radford, 1998).

On the whole, professional development programmes for teachers may be planned to increase their opportunity to achieve the ultimate goal of teacher professional development, which is improved learner outcomes (Guskey, 2002; Kisa & Correnti, 2014; Mayer & Lloyd, 2011). Supovitz and Turner (2000) find that teacher professional development may not only improve teacher education, but could be a means of improving the performance of science learners. Thus, improved teacher education may be reflected in teachers' interaction with learners in the classroom context. This is in agreement with Desimone's (2009) view, in that teacher professional development programmes may result in a change in teacher knowledge, skills, beliefs, and attitudes, which could lead to a change in teaching instruction. Consequently, the change in the teaching instruction of teachers could result in improved student learning. Johnson *et al.* (2007) find that learners who were taught by teachers who completed a teacher professional development programme performed better. A similar conclusion was reached in Yoon *et al*.'s (2007) study, in which the focus was on the effect of teacher professional development on student achievement. These authors are in agreement that learners who are taught by teachers who have completed a teacher development programme achieve better. Consequently, it is concluded that teachers who have completed a professional development programme influence learner outcomes.

It has been established in the literature that there are different forms of professional development programmes available to teachers. The choice of one form over another depends on the need and circumstances of the targeted group of teachers and schools (Desimone, 2011; Loucks-Horsely, Stiles, Mundry, Love & Hewson, 2010; Kedzior & Fifield, 2004). The National Policy Framework on Teacher Education and Development (NPFTED) in South Africa has categorised professional development programmes into four, namely: school driven programmes; employer driven programmes; qualification driven programmes; other programmes offered by nongovernmental organizations (NGOs), teacher unions, community-based organisation, private companies and faith-based organisations (DoE, 2005b).

It is argued that these categories may overlap, depending on who initiates the professional development programme. A qualification driven programme, for instance, may be initiated by the employer or by an NGO (DoE and South African Council for Educators, 2008). Therefore, the ACE NS may be viewed as a combination of the employer driven and qualification driven professional development programmes. It was the DoE that suggested that ACE be utilised for upgrade and re-skilling of teachers (DoE, 2000). This was discussed in section 1.2 of this thesis.

Villegas-Reimers (2003) cites examples of in-service training models as workshops, seminars, action research, coaching, and mentoring. Some of these models are similar to those mentioned by Loucks-Horsey *et al.*, (2010), although they mention some additional models; these are: lesson study, curriculum topic study, and study groups. A workshop as a form of professional development programme also emerged in Desimone's (2011) list, where she also mentions conferences, special institutes, and college courses. Kennedy (2005) and Loucks-Horsely *et al.* (2010) confirm these in their respective studies. Similarly, in another study conducted by Drago-Severson, Blum-DeStefano and Asghar (2013, p.17) training, observation, inquiry or collaborative action research, mentoring, individually guided or self-directed professional development, and coaching were identified as means of teacher professional development. However, it was suggested that there is no ideal model, but models may be implemented based on the purpose and context of the professional development programme (Villegas-Reimers, 2003). It is in this context that any teacher considering enrollment in a professional development programme should first think about the purpose and context thereof.

As noted earlier, some of these models of professional development programmes were criticized as being ineffective and not making an impact on classroom practice. As highlighted in Chapter 1, the workshops conducted for teacher development are one example of an ineffective model cited in the literature (Broad & Evans, 2006; Borko, 2004; Kisa & Correnti, 2014; Ono & Ferreira, 2010). This is in agreement with Lumpe (2007), who finds that teachers do not implement what has been learnt from a once-off workshop. He therefore proposes that research-based professional development be utilised instead. It is this researcher's finding, based on experience, that previously, some of these workshops were not informed by the teachers' needs, but were conducted for the sake of being able to report that teachers have been trained.

In recent times, some professional development programmes and workshops in South Africa have been informed by teachers' needs identified during the subject advisors' visits to schools, as well as the National Senior Certificate (NSC) and Annual National Assessment (ANA) diagnostic reports. Such diagnostic reports are meant to inform teachers' workshops and schools' improvement programmes (Department of Basic Education (DBE), 2014a; DBE, 2014b). However, it is yet to be established if teachers in schools are using these diagnostic reports to develop the school improvement plans in South Africa.

It has been established from previous research that for a teacher development programme to be effective, there are core features that must be taken into consideration when designing such a programme (Broad & Evans, 2006; Desimone, 2009; Garet *et al.*, 2001). These core features include: content that is challenging to learners in that it guides the development of the programme; an analysis of the results of the learners' assessment should inform the content to be covered in the programme; and a teacher development programme should be guided by teachers' needs. Furthermore, Mayer and Lloyd (2011) contend that effective professional development programmes should be orientated to teachers' needs, and should be school based because professional development programmes that are conducted at a site other than the school might not yield the desired results. Professional development programmes conducted outside of the school could expose teachers to sophisticated training facilities and equipment that are beyond their school's means.

Mayer and Lloyd (2011) further find that effective professional development programmes are organised around collaborative problem solving; they are ongoing and not just a once off kind of intervention. However, the once off kind of professional development programmes may work well in the event where information is disseminated without bringing about any changes in teacher behaviour (Kerka, 2003). Such programmes could be appropriate where policies are facilitated on new procedures. In contrast, Guskey and Yoon (2009, p.498) state that a long duration of the professional development programme does not guarantee effectiveness, "Long duration professional development does not necessarily make them effective because doing ineffective things longer does not make them any better". They further criticise workshops that are short and isolated. The core features of effective professional development discussed are in accordance with the characteristics of effective professional development, as discussed by Sandholtz and Scribner (2006).

2.3 INTERNATIONAL TEACHER DEVELOPMENT PROGRAMMES

Lesson study is a model of professional development programme that is implemented worldwide for teacher development purposes, and was first used in Japan before spreading to other countries. It has been established that the Japanese have been using this approach for professional development programme in their country for years (Ono & Ferreira, 2010). Attempts were made by the Japanese government to share the lesson study approach as a model of teacher professional development with developing countries like South Africa. Lewis, Perry and Murata (2006) mention Japanese lesson study as another form of professional development programmes that encourage teachers to reflect on their own classroom practices. A lesson study may be viewed as an activity for teachers to improve their classroom practice. Teachers plan the lesson together as a school or as a cluster of schools. The planned lesson is then presented among the teachers to identify some gaps before it is presented to learners. It should be noted that teachers participate in the lesson study voluntarily, and they know that participation in the lesson study does not lead to an accredited qualification. A study was conducted by Olson (2005) to explore the teaching practice of teachers who participated in a lesson study programme. It was found that teachers who participated in the lesson study became more confident in teaching. Furthermore, it was found that their beliefs about teaching and learning improved, consequently, their professional identity changed and improved. It was reported that the change in practice of these teachers was evident in class in that the learners were allowed to lead discussions, and the teachers started asking learners higher order questions.

A Professional Learning Community (PLC) is a form of teacher professional development that share features with the Japanese lesson study (Lumpe, 2007). Hamos, Bergin, Perez, Prival, Rainey, Rowel and van der Putten (2009), in their study on PLC in the mathematics and science partnership programmes, refer to the Japanese lesson study as an example of a PLC. In a PLC, a group of about seven teachers collaborate to learn from one another. These teachers view themselves as experts in a PLC (Jackson, 2010). The standard procedure in a PLC is that teachers meet on site or in a school in the community to explore new ideas and current classroom practices. Similar to a lesson study, a PLC does not lead to an accredited qualification, but to teacher development in terms of improved classroom practice. In addition, Vescio, Ross and Adams (2006) find that teachers who participate in the PLC become more learner-centred in their classroom practice. It should be noted that the learning communities in their study were ongoing and were held on a weekly basis. Lumpe (2007) conducted a study on research-based professional development where he discovered that the use of research can facilitate a PLC. He recommends that schools get rid of workshops and start implementing in-service training that utilises PLC principles. A PLC is unlike a professional development programme where teachers are enrolled for a particular fixed duration, instead, it relies on school initiatives and volunteering teachers.

Another professional development programme similar to the Japanese lesson study is implemented in China, which is called the Keli model. It is a school based in-service programme that was introduced by scholars, and therefore teachers participate in Keli model groups voluntarily. The Keli model group comprises interested teachers and researchers (Huang & Bao, 2006). The main aim of the Keli model is to update teaching ideas and design new teaching approaches to improve classroom practice. In addition, the Keli model process involves a group meeting to choose the content on which the lesson will be prepared. Each teacher designs a lesson independently, delivers the lesson to a class in a school while the Keli model group members observe the lesson, the whole group then meets after the lesson for feedback, the teacher then revises and re-designs the lesson based on recommendations from the feedback session, the lesson is then re-delivered to the same school but in a different class, and the Keli model group members will observe the lesson again. Similar to the lesson study and PLC, the Keli model does not lead to an accredited qualification.

In Swaziland, Stronkhorst and van den Akker (2006) conducted an international study on professional development investigating the effects of an In-service Education and Training (InSET) programme on the learner-centred style of teaching. The InSET programme was designed to change the classroom practices of teachers to make them more learner-centred. The study found that the dominant teaching practices in Swaziland Secondary Schools were teacher-centred, content-driven, examination oriented, note taking, memorisation, and recall based. Eight teachers were observed before they enrolled, while they were enrolled for the programme, and a year after completing it. Five of the eight teachers were inexperienced, and had a teaching experience of between three and five years. The other three teachers were experienced and had a teaching experience of between seven and sixteen years. It was found in this study that not all of the teachers responded the same to the InSET programme. It was further established that two of the experienced teachers did not change their teacher-centred style of teaching, and only one attempted to implement a student-centred approach. Furthermore, three of the inexperienced teachers struggled to involve the learners in their teaching, while two changed their practice by involving learners to a certain extent. It was concluded in this study that the design of a professional development programme should consider the professional development needs of the targeted teachers to make an impact on their classroom practice. This is echoed in the literature, as one of the design features of an effective professional development is that it should be informed by the needs of teachers (Broad & Evans, 2006; Desimone, 2009; Garet *et al.*, 2001). In fact, Stronkhorst and Van den Akker (2006) concluded that the needs of the targeted group of teachers should be investigated by fully exploring their views before enrolling in a professional development programme. The teachers' views were also used in the current study, in a different way, in an attempt to understand the teachers' classroom practice after completing a professional development programme.

Kvaternik (2001) conducted a study that was commissioned by the United Nations Educational, Scientific and Cultural Organization (UNESCO). The purpose of the study was to find out what distance education as a professional development method was used for and how effective it was. There were ten case studies in the UNESCO study. It has been established that in all of the case studies, there were no accurate statistics on the effectiveness of distance education as a means of professional development. Also, it was evident from the study that little was done to explore the views of teachers on their classroom practice after completing the distance education programme.

Another international study conducted by Buczynski and Hansen (2010, p.601) in the USA investigated how Inquiry Learning Partnership (ILP) professional development programme translated into classroom practice. This professional development programme targeted primary school teachers in the US, as it was argued that some of these were inadequately trained to teach science. The authors indicated that the ILP professional development "used standards-based content and inquiry-based strategies intended to provide rigorous mathematics and science instruction in elementary classroom". They also indicated that the approach used in the ILP programme included science subject knowledge lectures, hands-on experiments for teachers, demonstrations of inquiry practice, as well as teachers working in groups with science kits. The findings of this study revealed that 92% of the teachers who participated in the ILP professional development adopted the inquiry approach to teaching science. However, there were barriers encountered by these teachers when they attempted to implement what was learnt in the programme. A lack of resources was cited as a major challenge because the ILP professional development was not conducted in schools, but at locations where all resources were available. This concurs with other studies in that for a professional development to be effective, it must be school based as opposed to holding it at a venue where there will be resources that are not available in schools (Garet *et al.*, 2001; Mayer & Lloyd, 2011).

A different American study on professional development was conducted by Borko (2004), who found that a professional development system is made up of four elements: facilitators of the programme, the professional development programme, teachers who are the learners in the programme, and the context. The relationships between these elements are depicted in Figure 2.1.

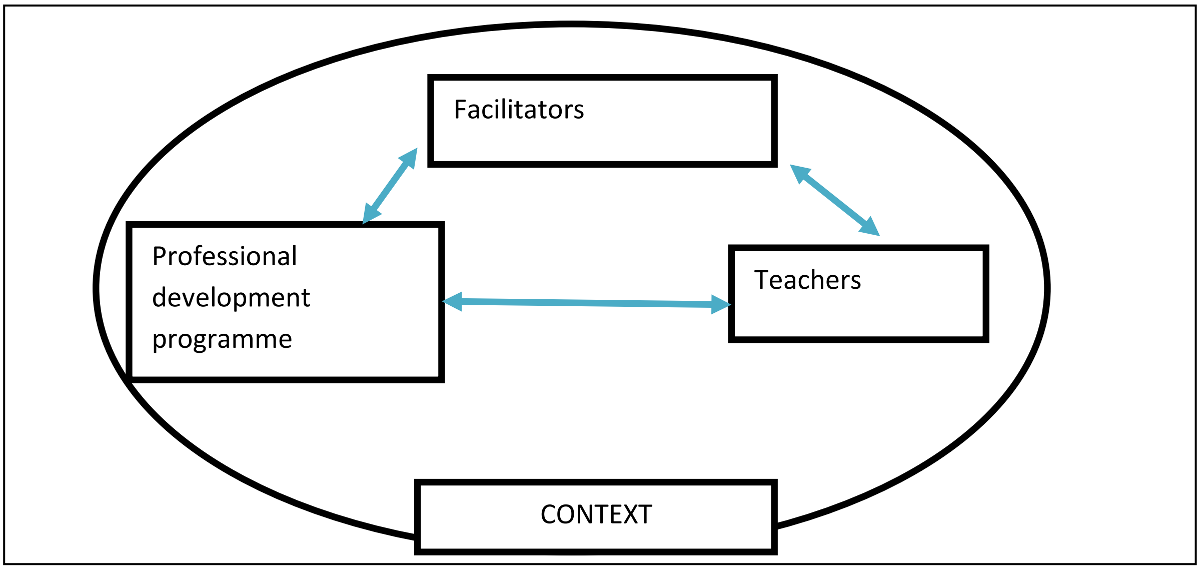


Figure 2.1: Four elements within a professional development system (Borko, 2004, p.4)

In Borko’s (2004) study, the landscape of research on teacher professional development is plotted by organising research programmes into three phases. She believes the phases “represent one way in which research activities in teacher professional development can move towards providing high quality professional development” (Borko, 2004, p.4). She views phase 1 as research activities that concentrate on one teacher professional development programme taking place in a particular venue. In addition, she explains that in phase 1, the researcher focuses on the professional development programme, the teachers, as well as the relationship between the two elements. Borko (2004) then clarifies phase 2 as research activities that concentrate on one teacher professional development programme taking place in more than one venue by more than one facilitator. In this phase, the researcher investigates the relationship among facilitators, professional development programmes and teachers without paying attention to the context. Phase 3, according to Borko (2004), focuses on a number of professional development programmes taking place in many venues. Researchers in this phase study relationships among all four elements of a professional development system. She concludes her study by arguing that there is still a lot of work to be done to provide "high quality professional development to all teachers", and researchers should work with professional development designers (Borko, 2004. p.11).

Banilower *et al.*'s (2007) study analysed the impact of teacher participation in Local Systemic Change (LSC) professional development that focuses on content. The LSC professional development model is depicted in Figure 2.2.

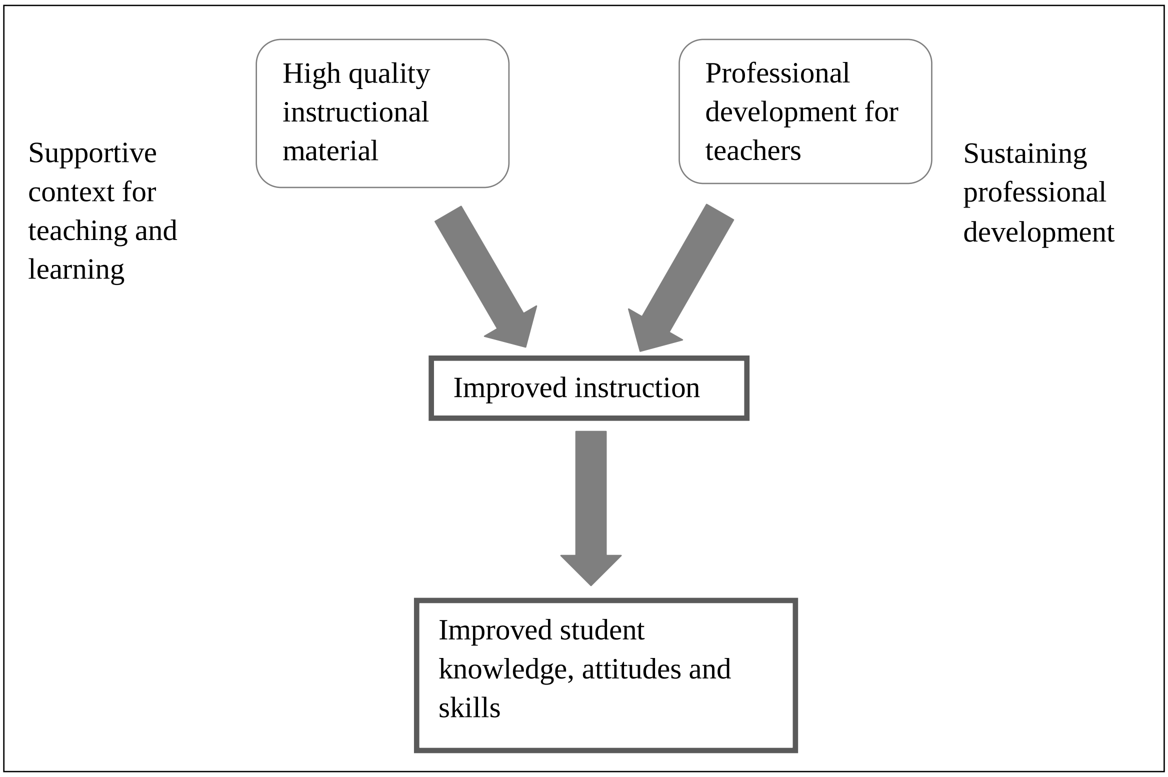


Figure 2.2: LSC professional development model (Banilower *et al.*, 2007, p.378)

The supportive context for teaching entailed the appropriate curriculum, assessment, and material management; time for teachers to plan and collaborate; and support for administrators, as well as support from parents and community (Banilower *et al.*, 2007, p.378). According to this model, the professional development of teachers using high quality instructional material leads to improved instruction, which in turn leads to improved student knowledge, attitudes and skills.

For improvement to take place, there should be a supportive context for teaching, and professional development must be maintained through capacity, structures, and resources (Banilower *et al.*, 2007). It was found in this study that teachers implemented the teaching material they were taught in the LSC professional development programme more when they were aware of a support system.

Blank and Alas (2009) also conducted a study on the effect of teacher professional development on learner performance in the US. The authors proposed the model depicted in Figure 2.3, in that a high quality professional development results in teacher knowledge and skills, which leads to improved teaching practice, which in turn, impacts learner performance (Blank & Alas, 2009). According to the authors, high quality professional development is content-focused, there is active learning, coherence, it has a longer duration, and teachers collaborate and participate actively. These are similar to some of the elements mentioned in other studies in discussing effective professional development programme (Garet *et al*., 2001; Mayer & Lloyd, 2011).

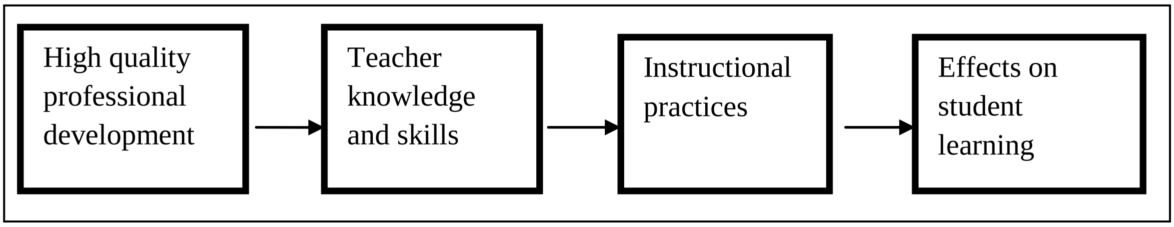


Figure 2.3: Logic model of teacher professional development (Blank and Alas, 2009, p.6)

Another study on teacher professional development was conducted by Carney, Brendefur, Hughes and Sutton (2014). The purpose of their study was to investigate the effects of the Mathematical Thinking for Instruction (MTI) professional development programme on knowledge, self-efficacy and the beliefs of teachers and administrators in the state of Idaho, America. This was a mandatory teacher professional development programme to be completed by teachers before their teaching certificates were renewed. The programme has three credits and its objective was to change the teachers' and administrators knowledge and beliefs about teaching mathematics. The MTI was designed such that it: takes teachers' ideas seriously; persuades teachers to relate and compare their methods of arriving at a solution for a mathematical problem; motivates teachers to use different techniques to arrive at the answer and represent it differently; and it tackles misconceptions through the use of representations and conversations.

It was found that the MTI professional development programme influenced the teachers' mathematical knowledge, self-efficacy and beliefs (Carney *et al.*, 2014). No mention was made of obtaining the views of the teachers on their new practices after completing the professional development programme. The teachers and administrators were tested before and after completing the professional development programme.

Another international study on professional development was conducted in North Carolina. It described a professional development programme where teachers were involved in curriculum development. There are five phases in this model of teacher professional development and these phases were implemented in a seminar approach where one phase leads to the next (Parke & Coble, 1997). The first phase is a conversation about research and national goals. In this phase, the teachers discuss education, their classroom and challenges, as well as read and discuss the latest research in scientific teaching and learning. The teachers are engaged in these activities so that they can think about their practice as science teachers. The second phase is the expression of personal beliefs. Parke and Coble (1997) argue that this is the phase where teachers incorporate the knowledge learnt from research in the first phase into their belief systems. The design of a curriculum is the third phase in which teachers develop lesson plans that are in line with the newly acquired beliefs.

The fourth phase is the alignment of curriculum with the school environment. In this phase, a supportive teaching and learning environment is created, among others, by clarifying the needs of learners and by discussing with the school administration other activities that can be carried out in the school environment to accommodate learners' needs. The fifth phase focuses on the design of an assessment, here teachers revisit the objective of assessing learners and the assessment becomes part of the lesson plans developed in phase three. This professional development model was found to assist teachers to cooperate with each other in exploring research expertise. This was done in an attempt to improve classroom practice (Parke & Coble, 1997). The authors conclude by saying that the "model of professional development support[s] teachers to be architects for change where they are allowed to implement innovative science teaching strategies based on research" (Parke & Coble, 1997, p.785).

Desimone, Hochberg, Porter, Polikoff, Shwartz and Johnson (2014) recently conducted a study that sought to investigate a distinction in the features of formal and informal mentoring as a professional development programme for teachers. They contended that there is a link between mentoring as a professional development programme, and teachers' practice. Districts provided formal mentors to teachers, while informal mentors were also chosen by the teachers. It was concluded that inexperienced teachers acquired assistance from the formal as well as informal mentors as their roles were found to be "complimentary and compensatory" (Desimone *et al.*, 2014. p.105).

Lumpe, Czerniak, Haney and Beltyukova (2012) investigated a teacher development programme to determine how it ultimately affected student learning. This programme was designed to enhance the teaching and learning of science in the lower grade in the US, where learner performance in science was a challenge. The programme targeted science teachers from two schools and the duration was 100 contact hours per year, with teachers attending sessions over the school holidays. It focused on inquiry based teaching, as well as scientific content. The teachers were also supported in the classroom by support teachers, and the programme facilitators, who were science lecturers from two universities. The support teachers were elementary teachers who were trained in the programme's content and supported the teachers on a full time basis. The programme design features of their study match the characteristics suggested in the literature as features of effective professional development (Broad & Evans, 2006; Desimone, 2009; Garet *et al.*, 2001). Teachers in that study developed through participation in the lesson study, and by observing master teachers teaching, as well as engaging in discussions about curriculum policies, and consequently, improved teacher learning. Lumpe *et al.* (2012) recommend that there is still a need for further studies on teacher professional development where links to "classroom practice, student beliefs and ultimately student learning will be established" (Lumpe *et al.*, 2012, p.163).

2.4 TEACHER DEVELOPMENT PROGRAMMES IN SOUTH AFRICA

Different models of professional development programmes are used in South Africa, like in the rest of the world, to develop teachers. The choice of professional development programme may be linked to teachers' training gap as opposed to only addressing the gap in the qualification value of teachers. In the first National Teacher Audit (NTA) carried out between 1993 and 1994 in South Africa, it was found that there are serious challenges in the education system. Among other challenges, a high number of under qualified and unqualified teachers in the education system was revealed (Joint Education Trust, 1995). Although the NTA has not specified the number of under qualified science teachers, it is assumed that science teachers were among those under qualified teachers reported to be in the system. The findings of the NTA ultimately resulted in some changes with regard to teacher education policies in South Africa (Mahomed, 2009). The changes that were introduced included the roles and competence for educators, as outlined in the Norms and Standards for Educators (DoE, 2000). Mahomed (2009) further explains that in South Africa, some progress was made in teacher development with regard to policies for the future initial teacher training and professional development programme. One of the indicators of progress made in teacher education is the requirement of four year initial teacher training (DoE, 2000), as opposed to the two year teacher training of the past.

Lesson study, as discussed in Section 2.3, is implemented in the Mpumalanga province for teacher professional development purposes. The Mpumalanga Secondary Science Initiative (MSSI) was implemented in partnership with the University of Pretoria and the Japanese government through the Japanese International Cooperation Agency (JICA) from 1999 to 2006. It was found that teachers' confidence in teaching science and confidence in terms of classroom practice were enhanced. This change was evident when the participating teachers, who started implementing the lesson study method, became more learner-centred in their classrooms (Ono & Ferreira, 2010). It should be noted that lesson study requires a learning culture among participants rather than a focus on obtaining a new certificate, or improving their qualifications alone (Lewis *et al.*, 2006). Thus, teachers who participate in the lesson study model are aware that lesson study does not lead to a qualification, but it could assist them to improve as mathematics and science teachers.

Rogan (2007) conducted a study in Mpumalanga province where the sampled school was one of the MSSI project school. The purpose of his study was to explore the way science teachers in a rural school reacted to the demands of C2005. Demands of C2005 were that the curriculum needed to be outcome-based as opposed to being content-based. Also, learners needed to construct their own knowledge, teachers needed to be facilitators of learning as opposed to only direct instruction. Teachers in C2005 were expected to be "qualified, competent, dedicated and caring" (DoE, 2002, p.3).

The implementation of the MSSI project in Mpumalanga coincided with the on-going teacher training on C2005 in South African schools. Subject advisors conducted InSETs related to the MSSI project as well as C2005 workshops. The focus of C2005 workshops was on curriculum requirements as spelt out in the policy document. The learning outcomes and assessment standards for OBE were discussed in these C2005 workshops. On the other hand, in the MSSI project workshops the focus was on the science activities that are activity-based and learner-centred. Teachers were trained in the hands-on science activities that were developed by all the partnerships in the MSSI project. In the main, developers of activities were encouraged to develop activities where teachers were to use improvised materials. This was done to accommodate project schools from poor backgrounds who did not have science apparatus.

Rogan (2007, p.115) interviewed and observed lessons of two science teachers in the sampled school. One teacher was responsible for grade 8 learners and the other one was a grade 9 science teacher. He found that the two science teachers did not use the traditional approach to teaching namely, "lecturing, reading from a textbook, questioning learners and writing notes on the blackboard". He further indicated that instead learners were actively engaged in the lessons, working in groups doing activities and constructed their own notes. Activity-based and learner-centred approaches to teaching were the preferred teaching strategies in C2005 as outlined in the RNCS document (DoE, 2002). However, it can be argued that the teachers prepared the learner-centred lessons to impress the researcher because he did not observe several lessons and this phenomenon could be linked to the Hawthorne effect as described by Leonard and Masatu (2006). Also, it could be that the teachers presented the learner-centred lessons that were developed by the MSSI partnership and mediated to them by the subject advisors.

Furthermore, Rogan (2007) found that the two teachers he studied came to grips with the new way of teaching as they implemented C2005. He concluded that the science teachers observed in his study had logistical and conceptual challenges as they implemented C2005. Moreover, he pointed out that though the two teachers in his study were involved in the professional development provided by the subject advisors, they still underutilized the resources that government provided. He subsequently, recommended a teacher training on the use of science resources. Rogan (2007) indicated that the two science teachers in his study used improvised resources but not the relevant science kits provided. This could imply that they preferred to use improvised resources because such resources were reflected in the lesson plans they were using. This was the possibility as lessons plans that were developed for science teachers in the MSSI project mainly required improvised materials. There was an understanding that most schools in the MSSI project were in rural areas and poor communities where there were scarce science apparatus. It could be against this background that the two teachers used improvised materials in teaching as opposed to the science kits provided. Rogan (2007) concluded that MSSI InSET succeeded in enhancing the professional development of the two science teachers. But he pointed out that they had concerns that C2005 was hastily introduced and they needed re-training to implement it effectively.

Steyn (2011) studied staff perceptions and the role of principals in professional development. It was found that the effectiveness of implementing changes in education depends on the quality of teachers. The quality of teachers may be improved through enrolling teachers in effective professional development programmes. Hart and Lee (2003, p.478) attest to this in contending that, "Professional development programme seeks to improve teachers' skills, thereby enhancing teacher quality". The National Framework for Teacher Education and development in South Africa advocates that employers should provide and sustain leadership and support of professional development programmes (DoE, 2007b). Therefore, the DoE, as an employer of teachers is expected to provide this leadership and support to teachers who enrol for professional development programmes.

Burton (2011) conducted a study in the Eastern Cape where the perceptions of teachers on the strategy used to help them implement what they had learnt from an ACE science course in the classroom were explored. The strategy comprised interactive notes that were given to the teachers, which included some notes to read, simple experiments and PowerPoint presentations from educational websites. These teachers were enrolled in ACE science at Fort Hare University, South Africa. It was found that not all of the teachers were able to access the strategy in the form of interactive notes. The teachers who lived far from the university did not apply what was presented in the strategy since they were unable to access the strategy online. Thus the teachers living nearer to the university performed better and were able to apply in their classrooms what they had learnt in the strategy. Consequently, the study was unable to fully determine the impact of the strategy on these science teachers' classroom practice. Despite some similarity between the current study and Burton's, it should be noted that Burton's (2011) study was conducted while teachers were still enrolled in the ACE programme and had not yet completed it. In contrast, the current study explored the views of science teachers on their classroom practices after completing an ACE programme and investigated the extent to which the outcomes of the programme were achieved.

Further Diploma in Education (FDE) programme is another S.A professional development programme that was offered to teachers with the purpose of improving their subject knowledge post 1994. Adler and Reed (2002) conducted a study focusing on teachers who participated in FDE programme between 1996 and 1999. Teachers received their training from former College of Education where they were under-prepared and therefore needed to improve their subject knowledge. The study investigated the teachers' take-up from the FDE professional development programme (Adler & Reed, 2002). The teachers' take-up from the programme was meant to establish whether teachers have integrated what they learnt from FDE into their existing teaching practices after completing (Adler & Reed, 2002). They found a "widespread take-up by most teachers of forms such as group work" (Adler & Reed, 2002, p.50). Groupwork was encouraged by the NCS, so it was possible that they were putting in action what was learnt. However, it should be noted that sometimes teachers resist change for a number of reasons, integrating what they learnt in the professional development might not be achieved at all times.

The ACE NS programme was one of the professional development programmes used in South Africa as discussed in chapter 1.-A study on the impact of the ACE programme was conducted by Aluko (2009), who investigated whether the graduates who successfully completed the ACE (Education Management) programme changed their professional practice or not. The change in professional practice was seen in the manner in which the graduates better understood, interpreted and implemented the policies. However, the study did not explore the views of teachers, or probe the extent to which the outcomes of the programme were achieved, while the current study has attempted to address this identified gap. Futhermore, there are no studies investigating specifically the effects of ACE programmes in Natural Science.Therefore, it may be concluded that this research was necessary as it addresses a gap in the literature.

2.5 THE CLASSROOM PRACTICE OF SCIENCE TEACHERS

Teachers' classroom practice varies from one teacher to the other. Previous research has found that classroom practice is related to teachers' knowledge and beliefs (Saad & BouJaoude, 2012). In this study, it has been argued that teachers' practical knowledge, knowledge about science, and teaching beliefs are factors that affect classroom practice. Furthermore, Luft and Roehrig (2007) also conclude that the classroom practice of teachers is linked to their beliefs. In addition to this, teachers' environment, learners' needs, and the school environment contribute to each teacher's individual classroom practice (Organisation for Economic Co-operation and Development for international student assessment [OECD], 2009). The OECD study explored the effects of teacher's beliefs and attitudes on classroom practices.

Classroom practice may also depend on the subject being taught, for example, the classroom practice in a mathematics lesson is not expected to be similar to that of a science lesson. Wenglinsky (2002) argues that in a science classroom, learners may be given more hands-on activities as compared to a mathematics lesson. In his study, he found that 80% of the science teachers' classroom practice was linked to hands-on activities, as opposed to 8% in mathematics. However, in cases where a teacher only uses a teacher-centred teaching approach, classroom practices may be similar to a certain extent between subjects. Kington (2014) explains that effective teachers do the following in their classrooms: explore ways of building relationships with learners; communicate high expectations to learners; get to know the students well; listen to students and communicate effectively; they establish good rapport and interaction; relate to students based on fairness, consistency and support; and set rules and boundaries at the outset of the lesson.

Blanton and Kaput (2005) conducted a study where they investigated the classroom practice of a Grade 3 teacher after completing a teacher development programme. They investigated a specific element of classroom practice, namely, the "reasoning skill" related to algebra. It was concluded in this study that the learners' ability to reason algebraically depended on the teacher integrating the required skill into her classroom practice. Consequently, it can be said that learners' reasoning skills depend on the classroom practice of their teachers.

Barrett (2007) conducted a study in Tanzania to investigate the way two teachers taught in their classrooms through lesson observations. She found that school culture, teacher participation in professional development programmes, personal traits, subject knowledge, and pedagogical skills affected the classroom practice of these teachers. In their study of effective classroom practice, Day, Sammons, Regan, Brown, Gunraj, Robertson, and Kington (2008) found that school climate, teacher-learner interaction, teaching organisation and management, classroom management, and teacher characteristics and values are factors that affect teachers' classroom practice.

It was discussed in section 1.1 and 1.3 of this thesis that there is a link between teacher development, classroom practice of teachers and learner performance. In addition, Wenglinsky (2002) emphasized the link between classroom practice and learner performance. This is in agreement with the arguments advanced by a number of authors (Desimone, 2009; Guskey, 2002; Jamil & Razak, 2012; Supovitz & Turner, 2000). Consequently, teacher development cannot be separated from classroom practice and it is for this reason that classroom practice of science teachers is relevant to discuss in the current study.

Connor, Son, Hindman and Morrison (2005, p.343) claim that "classroom practice is a black box". Thus, no one can tell exactly what it is that the teachers are doing in the classroom that influences learner performance positively. However, as indicated in Section 1.1, there are strategies that were found to influence learner performance positively. Some of these strategies indicated in literature are: allowing learners to work in groups, individualisation, using higher order questioning, continuous assessment, and a learner-centred teaching style (Kang'ahi *et al.*, 2012; Opdenakker and Van Damme, 2006; Wenglinsky, 2002). Furthermore, Harvey (1999, p.596) maintains that "subject knowledge, practical competence with experiments, pedagogical skills, language skills, classroom management skills and apparatus management skills" must be integrated in the everyday practice of science teachers. Subject knowledge and pedagogical skills were also mentioned by Barrett (2007) as factors affecting teachers' classroom practice. Danielson (2008, p.2) mentions that "what teachers do in their interaction with students is what matters most in influencing student learning". For this discussion, the elements that Harvey (1999) alludes to are regarded as fundamental to "what teachers do in their interaction with students". Thus, teachers' subject knowledge, practical competence in conducting experimentss, language skills, and pedagogical skills are discussed in details in this section as elements of classroom practice in science.

2.5.1 Subject knowledge

Although teachers' subject knowledge itself is not an element of classroom practice, it is the foundation on which classroom practice is based, and it is therefore discussed together with elements contributing to classroom practice. There are a substantial number of studies that have established that subject knowledge is an important contributor to effective classroom practice (Cabrera & Lanasa, 2002, Harvey, 1999; Kruss, 2009; Mji & Makgato, 2006). Some academics refer to subject knowledge as teachers' content knowledge. Subject knowledge is one of the elements that Harvey (1999) identifies as an important element that should be incorporated in any InSET of science teachers to enhance science teachers' classroom practice. Similarly, Mji and Makgato (2006) identify subject knowledge as one of the areas influencing the classroom practice of teachers. Furthermore, it is reasoned that teachers need to demonstrate knowledge of content in their planning and preparations (Danielson, 2008). This makes teachers' subject knowledge an important element of classroom practice linked to learner performance. In addition, the findings from a study conducted by Banilower *et al.* (2007) indicate that content knowledge is an important predictor of classroom practice.

Teachers' subject knowledge in the current study refers to teacher' ability to demonstrate knowledge of NS content. NS content, as reflected in the Natural Sciences Curriculum and Assessment Policy Statements (CAPS) Senior Phase document in South Africa, has been organised into four knowledge strands, which comprise: Life and Living, Energy and change, Planet Earth and Beyond, and Matter and Materials (DBE, 2011a). This content was similarly organised in the RNCS documents (DoE, 2002). Teachers' demonstration of subject knowledge is important to the improvement of their classroom practice, which could impact learner performance. The importance of subject knowledge to effective classroom practice cannot be overemphasised. It is in this regard that Garet *et al.* (2001) claim that teachers should have sufficient content knowledge, as this could empower them to handle any curriculum change related to the subject with ease. Research has shown that some science teachers struggle to teach science because of their inadequate subject knowledge (Dahar & Faize, 2011). In contrast, Loughran, Berry and Mulhall (2012) contend that subject knowledge alone is not sufficient to teach science.

Moreover, it is argued that science teachers should be specialists in their subject so as to improve learners' performance (Loucks-Horsely *et al.*, 2010). This is echoed by Adler, Pournara, Taylor, Thorne and Moletsane (2009), who contend that the improvement of mathematics and science education in South Africa may not be realised without paying attention to teacher education, with specific emphasis on these subjects. They explain that it is expected that teachers should have more content knowledge than what is prescribed in the curriculum policy. Teachers who were enrolled for the ACE NS were taught NS core knowledge and concepts, and thus their content knowledge was expected to improve upon completion of the programme, although this has not been established scientifically. Johnson, Hodges and Monk (2000, p. 181) explain, "Knowledge is a necessary condition for teachers to change, but it is not a sufficient one on its own". This suggests that there could be other elements other than subject knowledge that play a role in the enhancement of classroom practice. These authors further find that the knowledge *to* teach in the science classroom should be accompanied by the knowledge of *how* to do it, as well as the resources to be used (Johnson *et al.*, 2000). This emphasises the importance of resources in teaching science.

2.5.2 Practical competence with experiments

The second element of classroom practice identified from the literature is teachers' practical competence in conducting experiments, which was found to be an important skill that should to be integrated into the science classroom (Harvey, 1999). Logically, science teachers should have knowledge of the resources to be used for the practical demonstrations and conducting of experiments by learners. This knowledge of resources was cited by Danielson (2008) as an important element in the planning and preparation domain. Thus, it is this knowledge that could give science teachers the confidence to use laboratory equipment. Furthermore, research has shown that laboratory usage is one of the elements that influence learner performance in science (Mji & Makgato, 2006). Teachers who use the laboratory to conduct practical work with learners could spend less time explaining science concepts as opposed to teachers who are confined to teaching science through direct instruction only. In this study, practical competence in conducting experiments entailed the ability and willingness of a teacher to carry out experiments and preparation for practical work, including a demonstration of their knowledge of the resources to be used in the science classroom.

Science teachers need resources to teach science (Johnson *et al.*, 2000). Thus, the resources necessary to teach science include apparatus, consumable materials like chemicals, and teaching and learning materials like wall charts. Furthermore, the apparatus for practical demonstrations and conducting experiments constitutes the resources required for the teaching of science. The availability and use of these resources in the science classroom may enhance these teachers' classroom practice. Johnson *et al.* (2000, p.182) clarify that "A scientific study of the natural world requires instrumentation as well as conceptualization". The instrumentation that these authors refer to includes equipment, chemicals, specimens and textbooks. They indicate that in South Africa, resources are a challenge in most previously disadvantaged schools, yet they are essential to teaching scientific concepts. However, it should be acknowledged that some schools have resources, but these resources are under-utilised for practical work. Muwanga-Zake's (2001) study found that at times, science teachers were unaware of their challenges with regard to performing experiments. He carried out a survey in rural grade 7-12 schools in the Eastern Cape, South Africa, and found that teachers did not know their weaknesses in teaching science. The survey results suggest that teachers' problems, such as the inability to do practical work with learners, were as a result of the teachers' lack of understanding of science concepts and processes. Thus, it may be concluded that teachers who have an understanding of science concepts could have better practical competence in conducting experiments. Furthermore, he explicated that the teachers continued to demand science equipment, even though there was evidence of unused equipment in their schools. Therefore, the unused equipment in schools may be accounted for by the teachers' lack of competence in carrying out experiments using this equipment. In addition, Hattingh, Aldous and Rogan (2007) conducted a study in South Africa on factors influencing the quality of practical work in science classroom. They found that teachers had science equipment still in boxes and they related this to the teacher competence to teach science. However, there might be other factors that led these teachers not to use the scientific equipment in their schools.

In contrast with the above finding, Burton (2011) found that NS teachers who participated in her study admitted that they had never seen some of the apparatus in their life time, giving an example of a microscope. It is not clear in the study if they had seen other scientific equipment. It may be concluded from the findings of the two researchers that while in some schools there might be scientific equipment that is not utilised, in other schools there might be no scientific equipment at all. The competence of teachers in this regard is uncertain in the two studies.

South Africa is not the only country where practical work is often not conducted. In Dillon's (2010) study on effective practical work, different practices in different countries emerged. It was found that in Germany, where practical work is not assessed in final examinations, that the teachers preferred to do demonstrations instead of hands-on experiments conducted by the learners; in Brazil, the learners did not do practical work since practical work did not form part of university entry; in the United Kingdom (UK), large class sizes, a lack of resources, and a lack of qualified and skilled teachers in science are among the barriers that inhibit teachers' use of practical activities. In none of these cases is the teachers' competence in performing experiments mentioned as a barrier for learners in not being given opportunities to do experiments.

There might be numerous reasons for not doing experiments, but some studies have shown that teachers are aware that doing practical work with learners assists them to develop thinking abilities, including problem solving skills (Gabel, 1994; Science, Community, Representing Education (SCORE), 2008; Wallace & Kang, 2004). It is in this context that teachers' practical competence in this regard should be encouraged in the science classroom. Teachers should allow learners to do hands-on experiments under their supervision, or perform a practical demonstration where appropriate.

Teachers' attitudes towards practical work may have an impact on classroom practices in the science classroom. Teachers who were not exposed to practical work as learners themselves, while still passing the subject, may carry this experience forward. This is plausible as teachers teach science in a similar way to how they were taught (Abell & Lederman, 2007). Furthermore, Dillon (2010) claims that performing practical work should be incorporated in professional development programmes for science teachers and in their initial training programme. Such an inclusion in the professional development programmes for science teachers may inspire and prepare them to be competent in conducting experiments. In a study conducted by Radford (1998) on transferring theory into practice, it was found that teachers who participated in a professional development programme where they were trained in an inquiry based approach began to conduct more experiments with learners. In addition, their learners started to use the language of science, e.g. hypothesise, scientific method, safety rules, measuring and recording, more than before they participated in the professional development programme (Radford, 1998). It is acknowledged that it is not all the practical activities that enhance learning and develop conceptual understanding but only those that are carefully planned (Dillon, 2010). In addition, Millar and Abrahams (2009) argue that for practical activities to be effective, reasons for conducting such activities must be clear. These authors believe that if goals of conducting practical work are unclear, learners might not learn what the teacher wants them to learn.

2.5.3 Language skills

The third element of classroom practice identified from the literature is language skills. This element was identified by Harvey (1999) as a skill that should be incorporated in the everyday classroom practice of science teachers. He found that teachers required support to be able to plan learner activities that would expand their language proficiency. Language skills may enhance the assessment of student learning if given attention by teachers in the science class. Howie (2013, p.19) maintains that learners have to be fluent in English to learn mathematics and science. She further states that "weak language proficiency in English spills over to learning in subject areas". According to the Language in Education Policy (LiEP), South African learners may use their mother tongue for instruction up to Grade 3. As from Grade 4, the majority of learners are taught in a second language, which is mostly English. Language skills in the current study will be discussed in the context of teaching, learning and assessment in NS. South Africa has eleven official languages, and according to the language policy, schools are given the liberty of using any of the official languages for teaching in the foundation phase (DoE, 1997).

The South African science curriculum has been developed in English, which is the Language of Teaching and Learning (LoLT). Moreover, it has been developed based on Western trends and is mainly taught in English and Afrikaans (Muwanga-Zake, 2001). It should be noted that assessing learning in NS from Grade 4 is done in English or Afrikaans. Thus, this makes it necessary for learners who are not first language speakers to learn language skills so that they may perform better in subjects like science. A systemic evaluation report has shown that language is the greatest barrier to learning science (DoE, 2005a). The majority of learners learning science in English are not English first language speakers in South Africa. Hence it becomes important to enhance language skills in the teaching and learning of science. The teaching and learning of science may otherwise be more challenging if learners' language skills are not enhanced.

This is appropriate in view of the different languages that are spoken in different homes by learners in South Africa. The challenge is compounded if the mother tongue of the teacher is different from that of the learners. The reality of many learners in South African schools is that the LoLT is different from the language they use for communication at home. From the researcher's perspective, learners who struggle with the LoLT are likely to have low performance in science, for example, when learners are required to respond to higher order questions where they are expected to describe the process of respiration or to explain what keeps the planets in orbit, they might have an idea of the answer but be unable to respond in the LoLT. It was noted earlier that the majority of learners learning science in English in South Africa are not English first language speakers. Hence, some may struggle to understand scientific concepts.

The Progress in International Reading Literacy Study (PIRLS) 2006 report indicates that about 30,000 Grade 4 and 5 learners were assessed worldwide. The findings revealed that South Africa's Grade 4 and grade 5 learners achieved the lowest mean scores as compared to the other participating countries (Howie, Venter, Van Staden, Zimmerman, Long, Du Toit, Scherman & Archer, 2006).

Although these levels refer to reading literacy, it should be understood that these are the same learners who also take science. These low mean scores in reading may have a negative impact on their performance in science, as it was noted earlier that most of the South African learners are taught science in English.

Hanrahan (2009) conducted a study in Australia where she explored the literacy teaching practices of an Earth Science teacher. It was found that student learning in science is affected by the misunderstanding of terms frequently used in the science classroom. Moreover, it was concluded that the language of science can be taught as part of science without wasting teaching time on scientific content. It was explained that "Science learning is enhanced when the teacher helps students develop the literacy skills in a science lesson" (Hanrahan, 2009, p.291). In this regard, Monk and Osborne (2000) state that language provides the means by which new ideas are first introduced then repeated by learners to be understood even further.

Fleisch (2008) conducted an investigation on the underachievement of South African learners in mathematics and science, and found that when learners progress from Grade 3 to 4, there are linguistic transition challenges. In the foundation phase, which goes up to Grade 3, learners are mainly taught to read, write and count in their mother tongue. In South Africa, learners learn in a second additional language for the first time in Grade 4, which makes it more of a challenge when this language is used as the LoLT. This challenge was somewhat alleviated by the introduction of the CAPS document, which allowed for the use of a second language in the foundation phase of the schooling system. Villanueva (2010) contends that science teachers should teach the language of science while teaching scientific concepts. She found that the integrated teaching strategies approach does improve scientific literacy. However, she also found that science teachers did not want to teach reading in science, instead they focused only on scientific concepts. The strategy for teaching English across the curriculum suggests that the LoLT be developed by all teachers, science teachers included. Science teachers are required to assist learners in understanding the language of learning before presenting scientific knowledge. It is believed that the introduction of reading across the curriculum might enhance the learners' language skills (DBE, 2014c). This could also assist learners in developing the language skills necessary to learn science. It is therefore concluded that language skills are an important element of the classroom practice of South African teachers and could impact learner performance.

2.5.4 Pedagogical skills

The fourth element of classroom practice identified from the literature is pedagogical skills. The importance of subject knowledge for science teachers was discussed in Section 2.5.1, teachers need pedagogical skills to apply knowledge in the classroom (Irving, Dickson & Keyser, 2000). They argue that pedagogical skills enable teachers to transfer knowledge into the classroom. Harvey (1999) suggests that pedagogical skills should be integrated into the daily classroom practice of science teachers as this could make a difference in learner outcomes. Pedagogical skills, as proposed by Mji and Makgato (2006) include selecting instructional goals in the planning and preparation for teaching and learning, and selecting appropriate teaching strategies. The following discussion is organised in terms of the classroom management skills, use of constructivism, use of discrepant events, knowledge about learners and Pedagogical Content Knowledge (PCK).

Science teachers should acquire good classroom management skills because in the science classroom, management cannot be limited to managing time and maintaining discipline. It should also include managing resources to conduct experiments, as well as managing learning activities. Preparing apparatus in advance and ensuring that precautionary measures are put in place and adhered to, all these need to be managed. Learners could otherwise be harmed by hazardous chemicals if the teacher lacks classroom management skills. Millar and Abrahams (2009) outline the fact that learners remember and understand more of what they have seen and practically done, for example, some scientific concepts like an atom are too abstract for learners to understand unless they see a model that represents that concept. The resources used for learners to see and engage in practical work should be well managed and this requires good classroom management from the science teacher. Furthermore, Millar and Abrahams (2009) clarify that learners can undertake educational excursions and tours to observe some of the things learnt in the science class. Educational tours and excursions, like visiting an industry, zoo, or botanical garden, also require good management skills. However, teaching science practically and naturally should not rule out the explanation that science teachers should give to learners. Teachers should still explain scientific concepts to learners, especially those that are perceived by learners as difficult.

It is unfortunate that constructivist teaching is still minimal in the science classroom. Irving et *al*. (2000) contend that lecture method, demonstrations, textbook reading, memorization and direct teaching are still used in teaching science. Richardson (2003) proposes that in constructivist pedagogy, teaching should be student-centred, learning as a group should be promoted, and learners should determine, challenge, add or change existing beliefs as well as understanding. This is confirmed by Savasci (2006, p.26), who says that a "constructivist classroom should value student's questions, curricular activities be hands on, teachers teach from learners' prior knowledge, continuous assessment be implemented and use group work". Additionally, Muwanga-Zake (2001) mentions that asking questions, and predicting and testing are strategies that might allow learners to construct new knowledge based on their previous experiences. Learners could also work in groups helping one another to construct new meaning. Chi-Chung (2000) explains that learners' prior knowledge influences later learning. Chi-Chung's (2000) view on learners' prior knowledge is in alignment with what Monk and Osborne (2000) find that children learn science based on what they already know from their home and from the community, for example, children know from home that when they eat food it will be digested, then when children develop ways of thinking about digestion in a science classroom, scientific knowledge can be constructed. This is in agreement with the theory of constructivism as discussed by Taber (2011). Therefore, science teachers should take the responsibility of moulding and assisting learners to develop their understanding of existing experiences in the science classroom. These existing experiences in the science classroom should be based on real life examples that learners can identify with.

Another strategy to teach science successfully is the use of a discrepant event (Gonzalez-spada & Birriel, 2010). The use of a discrepant event was found to motivate learners in the learning of science. According to Gabel (2003), using a discrepant event is one of the teaching strategies that promotes the conceptual understanding of science. Longfield (2009) is of the view that the use of discrepant events sparks interest and gets learners excited about learning science. Consequently, using a discrepant event as a pedagogical strategy, the science teacher could inspire learners to learn. Learners could be more interested and willing to learn when teachers use discrepant events. Riendeay (2013, p.438) believes that discrepant events can cause learners to wonder why things did not happen as they are supposed to because "results are contrary to what they believe should happen". It is assumed that it could be interesting for learners to know that there are exceptions to the rule. Therefore, science teachers could use a discrepant event to promote learning in the science class by explaining how an exception has happened. Gonzalez-spada and Birriel (2010) claim that "It leads to more quality science learning going on in the classroom". Consequently, science teachers could develop their pedagogical skills and learner outcomes by using discrepant events.

In a study on the challenges that new science teachers face, Davis, Petish and Smithey (2006) have found that experienced teachers use their understanding of how learners learn science to select their teaching strategies. This is in agreement with Johnson *et al.* (2000, p.186), who previously argued that "Experienced teachers are able to run strategies through their minds and find faults that enable them to fine tune a teaching strategy". Their experience allows them to quickly sense that learners do not understand what is being taught, and they are then able to draw another strategy from their experiences. Furthermore, Johnson *et al.* (2000) discuss that teachers can change learning activities for different learners even if the topic of the lesson is the same. Their years of teaching allow them to accumulate a variety of teaching strategies, which provides a wide choice to select from in accommodating the various learning styles in the classroom. Accordingly, teachers' choice of teaching strategies and approach could be influenced by the understanding the teacher has of how learners learn science (Dekkers & Mnisi, 2003). It has been found that teaching strategies and methods could be selected based on teachers' understanding of learners. Similarly, Friedrichsen, Abell, Pareja, Brown, Lankford and Volkmann (2009) find that the different learning styles of learners should be taken into consideration when planning learning, teaching and assessment activities to keep learners motivated and interested in science. Montgomery and Groat (1998) contend that their experiences of teaching have taught them that learning styles inform their teaching strategies. In addition, they argue that an awareness of the learning styles of learners assists teachers to supplement their methods of lesson presentation accordingly. Teachers could also consider designing appropriate learning activities to accommodate different learning styles.

Stenberg (2011, p.17), who conducted a study on identities, focusing on students who are studying to become teachers, learnt that a teacher needs to be "aware of the sources of his or her pedagogical decisions, that is, personal values, beliefs and understanding". She believed that this would constitute self-knowledge, which could improve teachers because they would be conscious of their fears and assumptions. Furthermore, she argues that a teacher with good pedagogical skills would be able to read deeper into the meaning of learner behaviour, like shyness and rudeness. Consequently, it can be argued that a teacher with well-developed pedagogical skills would be able to select appropriate teaching strategies that could address these learner behaviours and stimulate learning in the science classroom.

PCK is also an important aspect of science classroom and therefore it is discussed in this section. Experience and novice teachers alike need to develop their PCK (Kind, 2009; Loughran et *al*., 2012). This is because even experienced teachers still struggles with some topics in science thus Loughran et *al*. (2012) further argue that PCK is not generic but content or topic specific. For example, this view suggests that a particular teacher with good PCK on chemical equilibrium might lack a PCK when it comes to teaching momentum. Karisan, Senay and Ubuz (2013) contend that PCK is moulded in the classroom and its lack limit learning and classroom practice. According to Loughran et *al*. (2012) the PCK format is comprises of Content Representation (CoRe) and Pedagogical and Professional-experience Repertoires (PaP-eRs) and these make the PCK useable by science teachers. Kind (2009) argues that developing CoRes gives teachers a better understanding of their practice concerning a certain science topic. She commended Loughran et *al*. (2012, p. 197) for developing CoRes however she criticized CoRes saying they are time consuming to complete, training is required for teachers to complete the first one, CoRes might be intimidating for some group of teachers. Nevertheless, I propose the use of CoRes and PaP-eRs by the science teachers to enhance their pedagogical skills. Also, the use of PCK for lesson planning is recommended by Otto and Everette (2012).

2.6 PROFESSIONAL IDENTITY

Teachers' professional identity refers to their beliefs, knowledge and attitudes about themselves as professionals (Cheung, 2008; Luft & Roehrig, 2007; MacGregor, 2009). It has been reported that teacher's beliefs, knowledge and attitudes are linked to their teaching practice (Luft & Roehrig, 2007; Stipek, Gyvvin, Salmon & MacGyvers, 2001). Luft and Roehrig (2007) conducted an exploratory study on the beliefs of teachers who were involved in an induction programme. The teachers in the study were interviewed and from the analysis of the interviews, it was found that their beliefs related to what they did in the classroom. This finding is in agreement with Battey and Franke's (2008) finding that teachers' classroom practice cannot be disconnected from what they know and what they think about themselves. Furthermore, teachers' professional identities are revealed when they are engage in practice. This is further supported by the case study of a mathematics teacher conducted by Shield (1999). It was found in Shield's (1999) study that the classroom practice of the teacher under study did at times reflect the teacher's beliefs about the subject, and teaching.

As noted earlier, Stipek *et al.* (2001) established that there is a link between teachers' beliefs and their classroom practice. Beijaard, Mweijer and Verloop (2004) conducted a study on professional identities where two studies on professional identity were reviewed. In both studies, they found that when teachers were asked questions about professional identities, they responded about what they know and do in the classroom. Consequently, the views of science teachers on their classroom practice cannot be explored without referring to their professional identity.

Traditionally, identity is thought of as an unchanging aspect of a person, and refers to the inner part of a person (Watson, 2006). However, the latest research on identity views identity as something that has to do with a person's relationship with others, which changes. It is in this context that Cheung (2008) and MacGregor (2009) claim that identity is not a fixed trait, but is created and recreated on a continuous basis.

There are different definitions on teacher professional identity in the literature, for example, Assaf (2008) views the professional identity of a teacher as related to the distinctive mixture of personal beliefs, temperament and knowledge, coupled with theories of learning as well as teaching. This definition brings to light the view that professional identity is a combination of factors. Cheung (2008) defines teacher professional identity as the way teachers define themselves to themselves and to other teachers. This self-definition may be reflected in the stories that teachers tell others and themselves about who they are (MacGregor, 2009). Similarly, Timostsuk and Ugaste (2010) define professional identity as the person's self-knowledge in a teaching related situation. They argued that the self-knowledge of a teacher can be observed in the practical professional activities of teachers.

It is argued that professional identity is more than what teachers know and believe about themselves and their classroom practices, but it includes their professional philosophy, passions, commitments, values and morals (Luehmann, 2007). It can be stated that these thoughts of self may be seen in teachers' daily interactions with learners and other teachers. In addition, Jansen (2001) defines professional identity as the way teachers feel about themselves professionally, emotionally and politically. This definition speaks to emotions and professionalism. As discussed, teachers' classroom practice cannot be easily separated from their knowledge and beliefs about the subject they are teaching, and about themselves.

Beauchamp and Thomas (2009) view teacher identity as a development of prior thought of self as the teacher reacts and negotiates given contexts and relationships in the teaching profession. The researcher argues that such a thought about oneself may change from time to time in the professional life of a teacher, depending on the context and the environment to which the teacher is exposed. Battey and Franke (2008) claim that the environment of the teacher, including histories and culture, modify identities. For instance in the relationships where a teacher is viewed as a hard working science teacher, the level of professional identity may be influenced positively. Alternatively, teachers who are criticised of being inefficient may experience a negative shift in their professional identity. It has been established that the professional identity formation of a teacher begins during the initial teacher training and is an ongoing process (Timostsuk & Ugaste, 2010, William, 2011). It can be argued that good teacher preparation programmes are critical in the initial training of teachers for the formation of their professional identities.

In Beijaard *et al.*'s (2004) study on professional identities, it was also found that teachers' professional identity formation is shaped by their involvement in discussions, sharing of ideas, learning a variety of approaches to solve problems in the subject content, policy context, and teaching traditions, among others. Thus, teachers' professional identity could be enhanced through these activities. Consequently, it is through these activities that teachers may reflect on their own perceptions, beliefs, experiences and practices (Cheung, 2008).

These activities could provide opportunities for teachers to know and define themselves better as teachers of science.

According to Diniz-Perreira (2003), culture is another factor influencing teacher professional identity. This is in agreement with Battey and Franke (2008), who indicate that culture is one of the factors influencing teacher identity. School culture may provide opportunities for teachers to have professional discussions that could enhance their professional identities (Darling-Hammond & McLaughlin, 2003).

Luehmann (2007) finds that the professional development programmes similar to the after-school collaborative teaching, such as organising and running a week-long summer camp for students, Saturday Science days, and science clubs could offer teachers opportunities where their professional identity will continually develop. These activities could provide science teachers with opportunities to search for information, to collaborate with other teachers and share best teaching practices.

It should be noted that teacher collaborations where professional identities are formed can also occur online. Grion and Varisco (2009) conducted a study to explore how some InSET teachers who were interacting online constructed their professional identity. These teachers were discussing their stories as well as experiences as teachers. This exercise was done individually as well as in a group online. It was concluded in the study that professional identity formation occurs online as well. Also, online was found to be a better option because teachers can be reached no matter where they are. However, I argue that teachers from rural and poor communities in S.A might struggle to access the internet. Therefore the use of internet could be a challenge to teachers who aspire to be part of this online professional development. The problem of access is mentioned by Fresen and Hendrikz (2009) in their study. The authors of this study conducted their study in S.A and found that only 1% of their sample had access to the internet. Fresen and Hendrikz's (2009) study targeted teachers from rural schools in South Africa. In my view the online approach of enhancing professional identities of teachers will advantage teachers who have access to the internet.

2.7 CONCLUSION

It has been established that professional development programmes are implemented to improve learner outcomes. The literature survey has revealed that there are a number of models and types of professional development programmes used nationally and internationally to improve teacher education. Some of these types have been criticised for being short, and not making an impact on learner outcomes. More success is expected from programmes over a longer period, like the ACE NS programme, which is completed over two years part-time. It was noted that most of the professional development programmes reviewed both nationally and internationally did not lead to a qualification, but were rather conducted for the continuous improvement of teachers. Cooperation between teachers is key to many such programmes.

Though little research has been conducted to explore the views of science teachers on their classroom practice after completing an ACE programme, there are studies that have been conducted to assess the impact of other professional development programmes on the classroom practice of science teachers. As discussed in this chapter, the study conducted by Steyn (2011) focused on staff perceptions and the role of principals in professional development. In Burton's (2011) study, teachers were still enrolled for the ACE programme when the study was carried out. Aluko's (2009) study was aimed at determining the impact of ACE in Education Management on the professional practice of graduates. Consequently, little has been done to probe the extent to which the outcomes of the ACE programme have been achieved. Different authors agree that teachers' subject knowledge, practical competence in conducting experiments, pedagogical skills, and language skills are important elements of classroom practice (Barrett, 2007; Harvey, 1999). It has also been established that teachers' classroom practice is linked to their professional identity (Battey & Franke, 2008; Luft & Roehrig, 2007). Chapter 3 discusses the models of teacher professional development, as well as the application of Clarke and Hollingsworth's (2002) model in the context of the current study.

CHAPTER 3 : THEORETICAL FRAMEWORK

3.1 INTRODUCTION

Chapter 2 presented a review of the literature. Chapter 3 focuses on the theoretical framework of this study. The literature survey discussed in Chapter 2 and the theoretical framework to be discussed shaped this study. This demonstrates that this study does not exist in isolation, but has been situated within existing theories. Different teacher professional development models were reviewed in an attempt to find the most suitable model for this study. Desimone's (2009) and Guskey's (2002) professional development models were examined first, however Clarke and Hollingsworth's (2002) model was selected as this model makes provision for more influences during professional development. Finally, the contextualisation of this study is discussed with reference to the chosen model.

3.2 GUSKEY'S MODEL

Guskey (2002, p. 381) states, "Professional development programmes are systematic efforts to bring about change in the learning outcomes of students". The model, as seen in Figure 3.1, proposes that teacher professional development programmes could lead to a change in classroom practice, which in turn could result in a change in student learning outcomes. Finally, the model indicates that it is this change in learning outcomes that will bring a change in teachers' beliefs and attitudes. Guskey (2002) contends that the change in the learning outcomes of learners would not be an immediate result of a teacher development programme. Figure 3.1 indicates that the change in the learning outcomes of students is only possible after change is effected in teachers' classroom practice. Subsequently, the learning outcomes of students precedes the change in teachers' beliefs and attitudes.

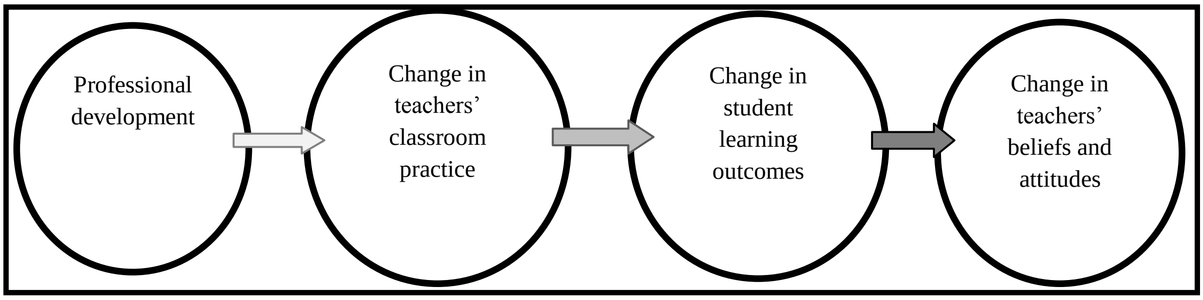


Figure 3.1: Model of teacher change (Guskey, 2002, p.383)

However, Guskey (2002) acknowledges that some teacher development programmes could be planned such that a change in teachers' beliefs and attitudes happen first. He argues that such teacher development programmes are designed so that teachers are involved in the planning of the programme (Guskey, 2002). In addition, he states that such a sequence could result in changed attitudes and better commitment from teachers before practicing what has been taught in a programme. Guskey's (2002, p.383) model proposes, "significant change in teachers' attitudes and beliefs occurs primarily after they gain evidence of improvement in student learning". He emphasises that this change in teachers' beliefs and attitudes can only manifest after teachers have witnessed how practicing their new knowledge or skills affects and improves learners' outcomes. He maintains that the sequence in his model is most appropriate because he believes that teachers' beliefs and attitudes can only change provided that teachers see learners' outcomes changing. I have noted that Guskey's (2002) model did not accommodate the possibility of teachers whose beliefs and attitudes might be directly developed after a professional development to an extent that this contributed to improved classroom practice leading to increased learning outcomes. As discussed in section 2.5 of this thesis, Luft and Roehrig (2007) concluded in their study that classroom practice of teachers is linked to their beliefs. Subsequently, I argue that the possibility of a link between the classroom practice and professional identity should be included in professional development models.

3.3 DESIMONE'S MODEL

Figure 3.2 depicts Desimone's (2009) model. Desimone (2009) agrees with Guskey (2002) as well as Clarke and Hollingsworth (2002) that change in teachers' beliefs, knowledge, classroom practice and student learning are the main features of a teacher professional development programme. However, Desimone's (2009) model differs somewhat from that of Guskey (2002). Firstly, as discussed in Section 3.2, Guskey's (2002) model starts with professional development, followed by a change in teachers' classroom practice, then a change in student learning outcomes, ultimately leading to a change in teachers' beliefs and attitudes. However, Desimone's (2009) model begins with professional development, which then leads to increased teacher knowledge, skills, attitudes and beliefs, followed by a change in instruction and ultimately, improved student learning.

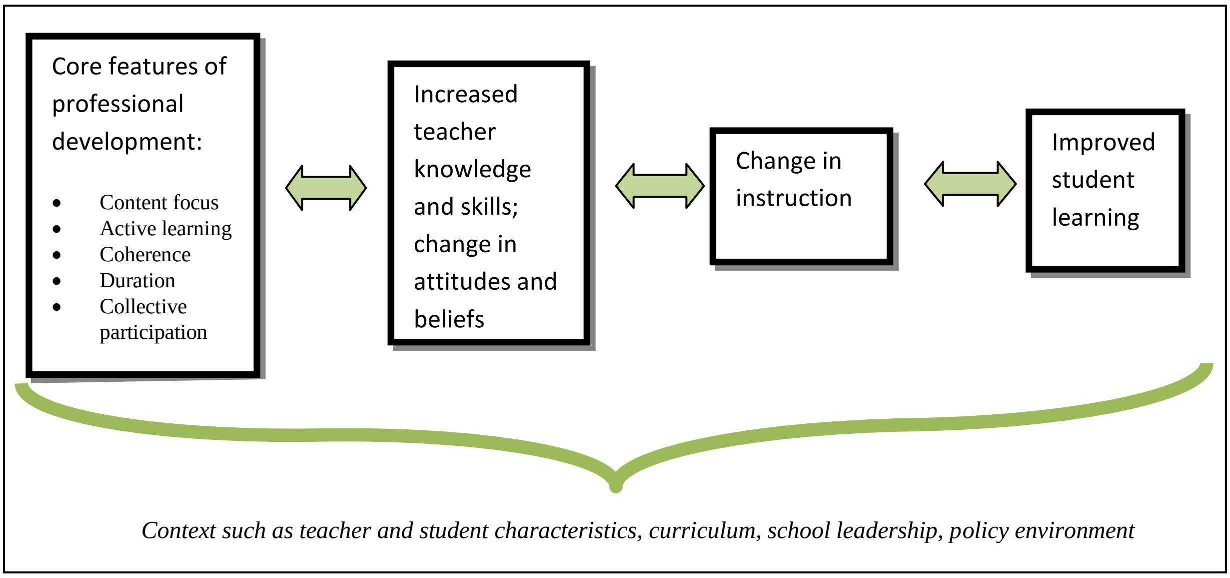


Figure 3.2: Desimone's model of professional development (Desimone, 2009, p.185).

In addition, Desimone's model has multidirectional arrows, while Guskey's model only has one-sided arrows. The multidirectional arrows in Figure 3.2 suggest that it can be interpreted from left to right and also from right to left. According to Desimone's (2009) model, a teacher professional development programme could result in a change in teacher knowledge, skills, beliefs and attitudes. Furthermore, a change in teacher knowledge, skills, beliefs and attitudes may lead to a change in the teacher's way of teaching, which in turn could result in improved student learning (Desimone, 2009), which is evident in learner outcomes like behaviour, performance or attitudes. Desimone (2009) explains that the features in her model are supported by several studies. The arrows moving to the left indicate that improved student learning could lead to a change in the teacher's way of teaching, and a change in the way of teaching may result in a change in teacher knowledge, skills, beliefs and attitudes. Then, the change in teacher knowledge, skills, beliefs and attitudes could lead to their professional development, which could mean that a teacher can contribute to developing others. This means teachers' professional development is enhanced when they see that learners' outcomes have improved.

It can be seen in Figure 3.1 that there is no direct arrow connecting the second and the fourth feature. This suggests that improved classroom practice may not contribute directly to a change in teachers' beliefs. In addition, in studying Figure 3.2, it is clear that there is no direct link between increased teacher knowledge and improved student learning, although, in her discussion, Desimone (2009) indicates that direct links between professional identity, classroom practice and student learning are possible. Desimone's (2009) model does not accommodate a situation where the improved teachers' knowledge, skills, beliefs and attitudes could lead to improved student learning. I argue that teachers' improved knowledge, skills, beliefs and attitudes may directly impact student learning. This argument supports Clarke and Hollingsworth (2002, p.959) who pointed out that there is no "alternative pathway" in the two models discussed above.

3.4 CLARKE AND HOLLINGSWORTH'S MODEL

Clarke and Hollingsworth's (2002) model provides "alternative pathways" of processes involved in teacher development. In this model, the professional development, classroom practice of teachers, as well as teacher's knowledge, beliefs and attitudes are interlinked. This model is not linear, but rather cyclical. Clarke and Hollingsworth's (2002) theoretical framework indicates the links between a teacher development programmes, professional identity, and the classroom practice of teachers. There are also paths linking learner outcomes to classroom practice and professional identity, as well as links between professional identity and classroom practice.

Clarke and Hollingsworth's (2002) model of professional growth was used for professional development as Hollingsworth (1996) finds that professional growth is the product of professional development. Thus, professional development could afford teachers with opportunities for professional growth. In addition, Loughran (2014) contends that professional growth occurs when a teacher interacts with learners and other teachers, or when they are enrolled in a professional development programme. Clarke and Hollingsworth's (2002) model comprises four interconnected domains, namely the external domain, domain of practice, domain of consequence and the personal domain, as shown in Figure 3.3. Firstly, inside the personal domain is the teacher's knowledge, beliefs and attitudes and these are associated with professional identity following the discussion in section 2.6. Secondly, inside the domain of practice is where professional experimentation occurs. Clarke and Hollingsworth (2002. p.950) argue that professional experimentation "encompass all forms of experimentation, rather than just classroom experimentation". For example, a teacher might try a new activity inside or outside the classroom. Also, professional experimentation could happen in the cluster where teachers share what was learnt in a professional development programme. However, Clarke and Hollingsworth's (2002, p.951) acknowledge that "much of the professional experience reported took place in the classroom". Thirdly, inside the domain of consequence are the salient outcomes. The salient outcomes according to Clarke and Hollingsworth (2002) could be outcomes of classroom experimentation as well as teacher's knowledge and beliefs about learner outcomes. An example of a salient outcome could be enthusiasm to teach science which could be as a result of the successful implementation of what a teacher has learnt in a professional development programme. Also, learner outcomes in terms of behaviour, attitudes and performance could be another form of salient outcomes. Fourthly, inside the external domain is the source of information or support or stimulus that provides professional development to teachers (Clarke and Hollingsworth, 2002). I argue that the source of information or support or stimulus can be a formal training that leads to a qualification like the ACE programme or a different form of teacher development programme like PLC as discussed in section 2.3 of this thesis.

The advantage of this selected model is that it is non-linear in nature, which suggests that a growth in teacher development may begin at any domain on the model. Furthermore, the model acknowledges that professional growth is not a simple process, but there are many possible routes in the process of teacher professional growth (Clarke & Hollingsworth, 2002).

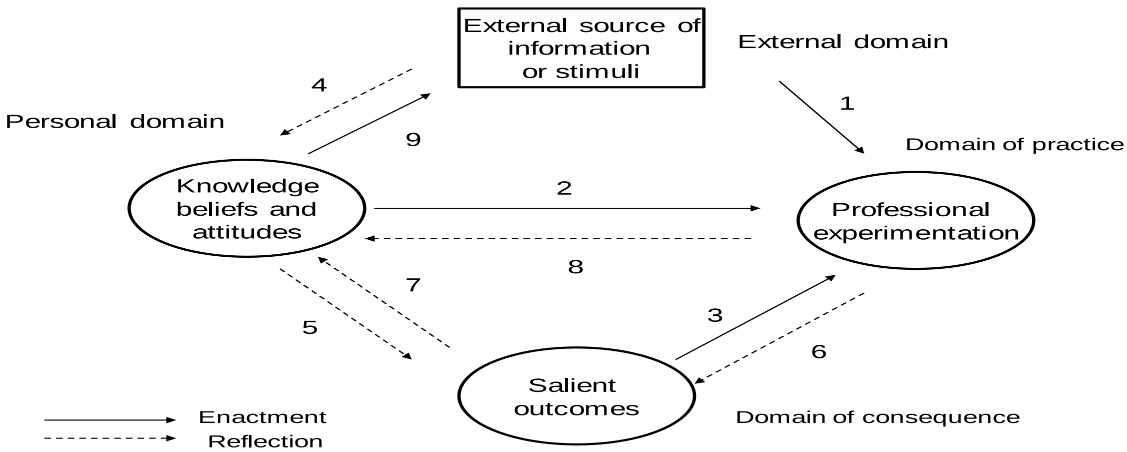


Figure 3.3: Clarke and Hollingsworth's (2002, p.951) model.

According to the model, change in each domain may take place through the mediating processes of enactment and reflection (Clarke & Hollingsworth, 2002). Enactment could entail using the new information and skills that teachers have obtained from the professional development programme, for example, teachers who have learnt to conduct a particular demonstration for learners could conduct that demonstration in the classroom. Reflection could refer to when teachers think deeply about something they have learnt in the professional development programme, or thinking about changed learner behaviours. They could reflect on the demonstration learnt in the ACE programme, and visualise how it can be contextualised to suit their learners. The processes of enactment and reflection are represented by solid lines and dotted lines respectively in Figure 3.3.

Figure 3.3 indicates that the professional experimentation taking place in the domain of practice could be as a result of three factors (see enactment arrows 1, 2 and 3). Firstly, arrow 1 is an enactment based on the external source of information located in the external domain moving towards the domain of practice. Teachers might learn formally or informally from a source outside the school that constitutes an external domain, for example, learning can be from a formal course like the ACE programme or a workshop organised by the DoE. Whatever the teacher has learnt, be it subject knowledge or teaching the strategy of a new approach in introducing a particular topic, could be implemented in the classroom. Secondly, arrow 2, is an enactment based on movement from the personal domain to the domain of practice. This could be as a result of the knowledge, beliefs and attitudes that the teacher has acquired and internalised from the personal domain. Teachers' knowledge and what they believe that learners should be taught could be trialled in the classroom. Thirdly, arrow 3 is an enactment based on movement from the domain of consequence to the domain of practice. The new learner outcomes, which could manifest as improved learner behaviour, positive attitudes, disciplined learners, and increased learner performance, could motivate teachers to work harder and continue to improve their classroom practice. Consequently, enhanced classroom practice could be achieved in three ways: as a result of direct implementation of the information that was taught in the ACE programme; a change in teachers' knowledge, beliefs, and attitudes, which concerns professional identity; or as a result of a change in learners' outcomes (Clarke & Hollingsworth, 2002).

Alternatively, teachers' knowledge, beliefs and attitudes located in the personal domain could be enhanced by the reflective processes represented by arrows 4, 7 and 8. Firstly, reflective arrow 4 moves from an external source of information. Teachers' knowledge, beliefs, and attitudes could be acquired by reflecting on information from any external source. The information teachers encountered in the ACE programme could transform their knowledge, beliefs and attitudes. The information offered in the programme does not translate into new knowledge without reflection and action, because change in behaviour requires time and effort to be put in by the teachers (Guskey, 2002). Secondly, enhanced knowledge, beliefs and attitudes could also result from their reflection on their professional experimentation in the domain of practice, represented by arrow 8. Thirdly, teachers' knowledge, beliefs and attitudes could also be enhanced in reflecting on learner outcomes in the domain of consequence as illustrated by arrow 7.

Teachers' knowledge, beliefs and attitudes could be enhanced if they received feedback approving their new practices. This approval could also come from other teachers in the school or from the cluster of schools in the area. This is in agreement with Jacobiene, Paulien and Verloop (2007), who find that teachers who try new ways of teaching sometimes become insecure about the newly acquired knowledge until other teachers approve it.

Hoekstra, Beijaard and Brekelmans (2014, p.191) explain that, "Teachers indicate that they learn through the activities of teaching itself". This suggests that teaching activities like assessing learners, supervising learners as they engage in activities; and keeping learners interested in the lesson enhances the knowledge, beliefs and attitudes of teachers.

Salient outcomes, as seen in Figure 3.3, is accounted for by two factors, namely, professional experimentation in the domain of practice, as well as teachers' knowledge, beliefs and attitudes in the personal domain. These are represented by reflective arrows 5 and 6 in Figure 3.3. Firstly, arrow 6 represents the teachers' reflection on the outcomes of their new classroom practice. Secondly, arrow 5 represents the teachers' reflections on the effect of their new knowledge, beliefs and attitudes on learner outcomes located in the domain of consequence.

Arrow 9 illustrates a possible enactment where teachers with improved knowledge, beliefs and attitudes contribute to activities in the external domain. This could happen when teachers with improved professional identity participate in the development of other teachers. The participation of teachers in the external domain could be formally or informally executed.

3.5 CLARKE AND HOLLINGSWORTH'S MODEL IN THE CONTEXT OF THE CURRENT STUDY

In this section, Clarke and Hollingsworth's (2002) model is contextualised in terms of the current study. The model is discussed starting from the external domain moving clockwise. In the context of this study, the external source of information was linked to the ACE NS programme that the participants completed. The external source of information represented the ACE NS programme, including all the subject knowledge, professional knowledge and skills taught, as well as all the experiences the teachers were subjected to during the programme. In future, teachers who have completed the ACE NS programme could participate in other teacher development activities, sharing knowledge and skills that contribute to the professional growth of other science teachers, for example, in teacher cluster meetings. Such activities would be represented by enactment arrow 9 in the adaptation of Clarke and Hollingsworth's (2002) model, shown in Figure 3.4.

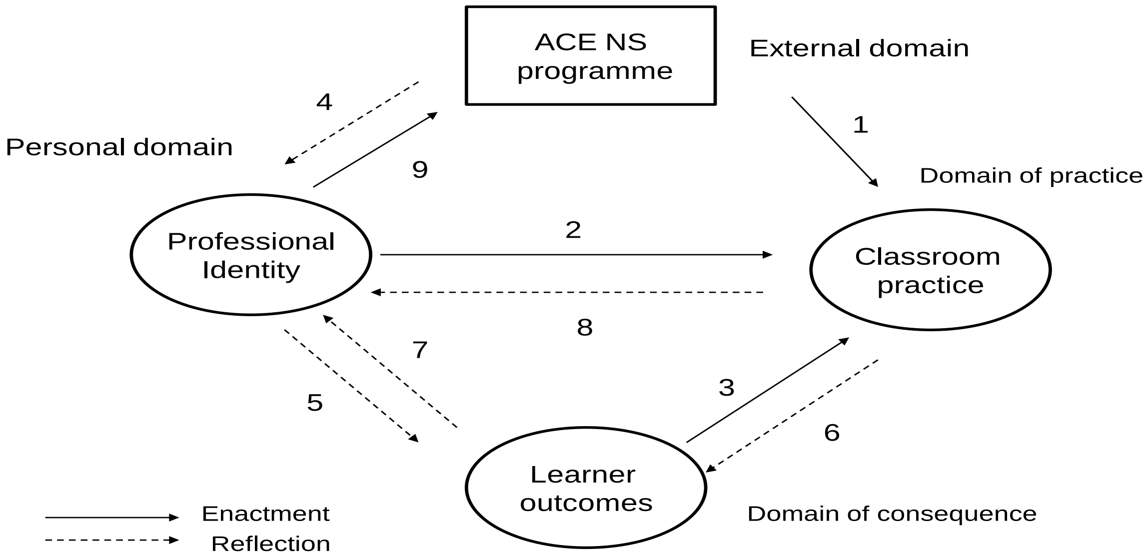


Figure 3.4: Clarke and Hollingsworth's (2002) model (adapted to suit the current study).

The second domain titled the domain of practice in Clarke and Hollingsworth's (2002) model represents professional experimentation. This domain is associated with the classroom practices of science teachers, including the application of the information and skills the teachers received in the ACE NS programme. It is in this domain where teachers practice what they have been taught in the ACE NS programme. The HoDs, as well as subject advisors can motivate teachers who have completed the ACE NS programme to practice in the classroom what was learnt in the programme. As already discussed in Section 3.4, Hoekstra *et al.* (2014) maintain that teachers require motivation to practice what they have learnt in a professional development programme. It is in this light that HoDs and subject advisors should visit teachers who have completed the ACE programme and encourage them to experiment in their classrooms with the new knowledge and skills acquired in the ACE NS programme.

Clarke and Hollingsworth (2002) suggest that teacher experimentation should not be limited to the classroom. Teachers could try new ideas learnt in their own teacher development sessions, for example, in the lesson study or PLC. In such professional development sessions, other teachers and HODs could affirm and support new classroom practices before they are implemented in the classroom.

The third domain in Clarke and Hollingsworth's (2002) model is the domain of consequence, which represents the learners' outcomes. The changes in the learners may include the learners conducting experiments, handling apparatus, enjoying doing their NS assignments and homework, changed behaviour, motivation to learn science, and an improved performance in science. Teachers may not have consciously planned for such changes, but these may be observed in learners as a result of teachers' enhanced classroom practice and professional identity. While outcomes can be interpreted in ways other than learner outcomes, the meaning is restricted to learner outcomes in this model.

The fourth domain in the model is the personal domain, which represents the professional identity of teachers in the study. This domain includes teachers' processed and changed knowledge, beliefs and attitudes. Also, this domain could include the information that was taught in the ACE NS programme and internalised by teachers as knowledge. Professional identity in the study therefore entails the knowledge, beliefs and views teachers hold of themselves. This could include their confidence to teach science and to share their new attitudes, beliefs and knowledge in school cluster meetings.

Figure 3.4 indicates that teachers' classroom practice may be changed by the enactment of the three other domains. The three domains that could enhance classroom practice are the external domain where the ACE NS programme is situated, the domain of consequence where the learner outcomes are located, and the personal domain where the professional identity of teachers is situated. Firstly, arrow 1 in the model links what the teachers have been taught and have experienced in the ACE NS programme with what they may duplicate directly in their classrooms. Teachers may have observed and experienced new classroom practices relating to subject knowledge, doing experiments with learners, pedagogical skills, and language skills from the ACE teacher professional development. When teachers try out this information and these skills, improved classroom practice may be evident in the science classroom. On the whole, what was learnt in the ACE programme could be experimented with in the science classroom. Some of the ideas learnt could also be trialled in cluster meetings where teachers collaborate and learn from one another.

Secondly, enactment arrow 2 links knowledge, beliefs and attitudes with what the teachers might practice in the science classroom. The enhanced professional identity of teachers may result in the improvement of teachers' classroom practice. This could be seen from teachers' improved confidence in explaining scientific concepts to learners. Such confidence could suggest that the teachers' knowledge, beliefs and attitudes have improved. It is argued that the teachers' inner beliefs, values and understanding guide their teaching practices (Stenberg, 2011). Therefore, the enhanced professional identity of teachers could lead to improved classroom practice.

Teachers' classroom practice could be further enhanced by enactment based on the learner outcomes represented by arrow 3. Improved learner behaviour, motivation and performance could enhance the classroom practice of teachers. When teachers observe that learners' outcomes improve, this could motivate them to work harder and continue with a new classroom practice.

Arrows 4, 7 and 8 in the model affect change in the personal domain, which refers to the teachers' professional identity. Reflective arrow 4 implies that teachers' professional identity could be enhanced when they think deeply on the information taught in the ACE NS programme. Once internalised, this information could improve the teachers' professional identity. The fact that teachers' knowledge has improved might not be observed immediately in their behaviour. Jacobiene *et al.* (2007) argues that what teachers learn may remain as knowledge for a longer period before a change in behaviour is observed. Reflective arrows 7 and 8 represent teachers' deep thoughts on learner outcomes and their classroom practice respectively. Such thinking could lead to a better understanding of learners' needs and their own classroom practice. According to arrow 8, the new information acquired from the ACE NS programme, trialled in the science classroom, could impact the knowledge, beliefs and attitudes of teachers in the teaching of science. Similarly, according to arrow 7, the new learner outcomes in terms of behaviour, performance, interest in learning science, and discipline in the classroom could enhance the professional identity of teachers.

There are two reflective arrows involving the domain of consequence. Reflective arrow 5 represents teachers' thinking deeply about themselves as science teachers, which could result in a change in their attitudes. Such improvement, in turn, could enhance learner outcomes. Teachers' enhanced professional identity could be projected in learner behaviour, performance, interest in learning science, and discipline in the classroom. In addition, reflective arrow 6 links classroom practice and learner outcomes. When teachers think deeply about their classroom practice, this could lead them to identify the challenging aspects of their practice and improve it, which could enhance learner outcomes.

The last arrow, arrow 9, could be viewed as a teacher having enhanced professional identity that enables them to act as a resource person in the school, the cluster and the community. Such a teacher would be resourceful for future DoE programmes. Thus this teacher would provide continuing teacher professional development to other teachers and could play a role as a source of information in the external domain.

3.6 CONCLUSION

Three models of teacher professional development were discussed in this chapter. It was found that the three models contained similar elements regarding teacher development. Guskey (2002) argues that these elements are the goals of teacher professional development programmes, and as discussed earlier, they refer to a change in teachers 'classroom practice, knowledge, beliefs and attitudes, as well as improved learner outcomes. The difference in the three models of teacher professional development discussed was found to be the order in which the elements are assumed to develop. Also, the essential feature distinguishing Clarke and Hollingsworth's (2002) model from the other two is its cyclical nature, while Guskey (2002) and Desimone's (2009) models were linear. However, as indicated in Section 3.3, Desimone (2009) emphasises that direct links between professional identity, classroom practice and student learning are possible. Clarke and Hollingsworth's (2002) model was selected as the most appropriate for the current study because its cyclical nature gives "multiple entry points" (Clarke & Hollingsworth's, 2002, p.949) whereby the reinforcement of changes in different domains can be understood. Teachers' classroom practice, for example, could be enhanced because of the improved learner outcomes, and also because of the teachers' improved professional identity.

CHAPTER 4 : RESEARCH METHODOLOGY

4.1 INTRODUCTION

The theoretical framework of the study was discussed in Chapter 3, while Chapter 4 focuses on the research design. According to Babbie and Mouton (2010), a research design entails a plan to be followed in conducting research. In more detail, it is a preparation indicating how the sample will be selected, what instruments will be used and how the data will be collected for a study (Maree, 2007). He further clarifies that this preparation is informed by the researcher's fundamental theoretical assumptions. In addition, Henning, Gravett and Van Rensburg (2006) view the research design as one of the five pillars of any research project. The other four pillars mentioned are the topic, unit of analysis, main research question and the aim of the study.

Consequently, the research design for this study is discussed considering the aim of the study as well. The aim of the study, as indicated in Chapter 1, was to explore science teachers' views on their classroom practice after completing an ACE NS programme, and to probe to what extent the outcomes of the programme have been achieved. The research paradigm, sample selection, data collection, data analysis, trustworthiness of the study and ethical considerations are discussed in this chapter.

4.2 RESEARCH PARADIGM UNDERPINNING THE INVESTIGATION

The interpretive research paradigm was found to be the most suitable to achieve the aim of this study. Interpretive studies, as spelt out by Maree (2007), seek to understand experiences through the meaning that respondents give to their experiences. In this study, the views of science teachers were sought through interviews, and interpreted to get a better understanding of their classroom practice after completing an ACE programme. The researcher was involved with the teachers in their own schools and visited each of the four teachers in the classroom six times to observe their classroom practice. Andrade (2009, p.42) finds that, "[The] interpretive approach provides a deep insight into a complex world of lived experienced from the point of view of those who live it". In this study, the teachers revealed their views on what they expected to learn and what they actually learnt in the ACE programme, providing the researcher with insight to understand their classroom practice.

Teachers' were interviewed, lessons were observed, and documents were analysed. The data was interpreted considering the context of their background information.

4.2.1 Qualitative research

In order to explore the classroom practices of teachers after completing a professional development programme, a qualitative investigation was found to be suitable. Their views on classroom practice after completing the ACE programme were explored. A qualitative approach to the research was used to obtain an understanding of the views of teachers on their classroom practices from their own school environment (Creswell, 2007; Esterberg (2002).). Also, it allowed a description and interpretation of the views of teachers of their classroom practice. As indicated by Silverman (2014), in qualitative research, the researcher should have direct access to what is happening, for example, by visiting teachers in their schools and classrooms.

4.2.2 Epistemology

Krauss (2005, p.759) proposes that, "Epistemology poses the questions: What is the relationship between the knower and what is known?; How do we know what we know? and What counts as knowledge?". In the context of this study, knowledge on the teachers' views about their classroom practice after completing the ACE programme was constructed by interviewing the four participating teachers in this study. The researcher observed how they taught and analysed learners' workbooks and teachers' documents, as well as records. Schools were the natural environment for these teachers and it was where the knowledge about their views on classrooms practice was constructed (Henning, Van Rensburg & Smit, 2004). The phenomenon under study in this research was the classroom practice of teachers who completed the ACE programme. Krauss (2005) states that constructivists establish knowledge by attaching meaning to the phenomena under study. This claim is supported by Merriam's (2002) view that in qualitative research, reality is constructed. The collected data was interpreted in the light of the literature reviewed, and the theoretical framework on which this study was based.

4.2.3 Possible biases of the study

"In qualitative research, the researcher is directly involved in the setting, interacts with the people and is the instrument" (De Vos, Strydom, Fouché & Delport, 2005, p.314). These authors further advise that one should disclose biases, values and contexts that might influence the narratives in the study. Firstly, the source of bias in the current study was linked to the researcher's experience of working with science teachers in supporting schools in one of the provinces in South Africa. The bias in this case could be to expect teachers' lesson preparations to be similar to how the researcher used to train teachers in her province. Such possible biases were addressed in this study by the use of a lesson observations schedule and document analysis guide. These instruments provided the guidelines and criteria that were used during data collection. The elements and criteria used in the observations schedule and document analysis instruments were informed by the elements that needed to be confirmed from the interviews.

Secondly, as the researcher was directly involved with the teachers for data collection purposes, care was taken that her own experiences and philosophy of teaching were isolated. This isolation was enforced by respecting the individual teacher's teaching style. The researcher did not expect her personal preferences from the teachers and learners. Furthermore, she reminded herself to be an objective observer and her role as a researcher was maintained throughout the study. This was possible because the researcher was not only drawing conclusions from the collected data, but drew meaning from the research context (McMillan & Schumacher, 2001). It is in this regard that the background of the teachers was taken into consideration during data analysis.

The biases and weaknesses of the current study that relate to the small number of participants were also addressed. These biases and weaknesses were addressed by observing more than one lesson per participant. It has been discussed in Section 4.4 in this thesis that six lessons per participant were observed. This was done to minimize the weakness where teachers would present their only one best lesson. In addition, the researcher did not choose the lessons to be observed, a school timetable was followed in all the lessons observed. Therefore, there was no special arrangement made. On the whole, possible bias and personal feelings were addressed in the current study.

4.2.4 Case study

A case study was selected as the most appropriate design for this study. Rubin and Babbie (2013) view a case study as a particular examination of a phenomenon. Creswell (2007, p.73) states that "Case study research is a qualitative approach in which the investigator explores a bounded system (case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information". As already indicated earlier in this study, the teachers' classroom practice following their participation in an ACE programme is phenomenon that was examined in-depth. The researcher explored four cases using multiple sources of information. Furthermore, Rubin and Babbie (2013) state that a case is examined with the purpose of describing it, which was done in this study.

Yin (2014) proposes that the evidence used in a case study could be derived from six sources, namely, documents, archival records, interviews, direct observation, participant observation and physical artefacts. In this study, interviews, lesson observations and document analysis were used to source evidence, allowing a triangulation of the data.

4.3 SAMPLE SELECTION

The sample for this study was purposefully selected. Maree (2007) and Creswell (2007) find that qualitative research generally employs non-probability and purposive sampling. Furthermore, Maree (2007, p.79) states that purposive sampling becomes a choice when the researcher endeavours to obtain "the richest possible source of information to answer the research questions". This was applicable in the current study as purposive sampling was conducted to acquire the "richest possible" information. Teachers who have completed the ACE NS programme in a well-established, specific institution of higher learning were particularly targeted. The data base of the teachers who completed the ACE NS programme and the profile of the schools were sourced from the DoE in a specifically chosen province.

It was initially planned that the diverse backgrounds of the participating teachers would be accommodated by referring to the profile of their schools. There were no teachers from former model C schools in the list sourced from the Provincial DoE. This is understandable as teachers in these schools are usually well qualified and thus did not enrol for the ACE programme. In the selected sample, three of the four teachers were from township schools, and one teacher was from a farm school, however, there were no teachers from urban and suburban communities in the sample.

The process of sampling the four teachers unfolded following the approval of the Ethics committee at the University of Pretoria and the Provincial DoE. The office of the Provincial DoE was visited to request the data base of teachers who had completed the ACE NS with the specific institution that provided the programme, referred to in this study as the 'Service Provider'. There were 28 teachers who completed the ACE science programme with the

Service Provider in the database. The database was then scrutinised and as indicated, it was found that teachers from former model C and private schools were not listed. This naturally excluded teachers from these schools to be part of the current study. The teachers in the database were contacted to establish the grades they were teaching in the NS Senior Phase. There were different responses received, and eight of the teachers could not be traced. 15 teachers indicated that they were not teaching natural sciences for Grade 7. Four of the 15 teachers were promoted to principal posts and were no longer teaching natural sciences, eight indicated that they were teaching Grade 6, and three said that they were teaching Grades 9 in 2013, the year when the data were collected. It thus came down to five teachers who said that they were teaching NS in Grade 7. These five teachers were from schools located in previously disadvantaged communities. The researcher then made appointments with the schools of the five teachers, but only met four because one teacher was not at school on the day of the appointment. A second appointment was made with the fifth teacher but he was again unavailable and was therefore excluded from the study. Consequently, four teachers who were teaching natural sciences for Grade 7 were available who agreed to participate in the study and their biographical information was collected using a form. A copy of the biographical information form is attached in this research report as appendix 2.

The biographical information form was given to the four teachers to collect their biographical details and to record the background details of their schools. The biographical information form comprised two parts. Part A focused on the school information, and part B on the teachers details. Each of the four sampled teachers was requested to complete the biographical information form about the background of the school and their biographical details. These forms were completed and collected during the first visit to the schools. The biographical information were summarized to better understand the context of the teachers and their schools, as reflected in Tables 4.1 and 4.2.

4.3.1 The participants' context

As already indicated, the criteria for selecting the sample was that the teacher should be teaching natural sciences in Grade 7, and had to have completed the NS ACE programme at the selected ACE Service Provider. In the study, the four teachers selected met the criteria and their pseudonyms are Ms Ntombela, Mr Wakithi, Mr Zulu and Mr Mashangura. The pseudonyms chosen for their schools are the Ntonto, Waiting, Mngwenya and Mashaning Primary Schools respectively.

4.3.1.1 Mr Wakithi's context

Mr Wakithi was a teacher who had accumulated 11 years of teaching experience in Grade 7. His highest qualification before enrolling for the ACE programme was a Senior Primary Teacher's Diploma (SPTD). Mr Wakithi was a post level one teacher, which is the lowest level. Mr Wakithi's school was a farm school located just outside of an old, small town. Most of the learners came from the farms in the vicinity of the school. Some learners were observed travelling between the school and the neighbouring squatter camp, which was approximately three kilometres from the school. The administration block was built from bricks and cement, and the classrooms were prefabricated. These prefabricated classrooms were made out of hard ceiling boards. Mr Wakithi indicated that there was no laboratory in the school, hence he stored the few apparatus he had in the cupboards of different classrooms. There was running water in the school, but they heavily relied on water drawn from the borehole. Furthermore, it was observed that there was electricity in the school and teachers were able to request the secretary to type their assessment tasks for different subjects, as well as make copies for learners.

4.3.1.2 Mr Mashangura's context

Mr Mashangura had been teaching for 22 years in this primary school and he was still a post level one teacher as well. His qualification before obtaining the ACE was a Further Diploma in Education (FDE). This was a two year part time diploma to upgrade the qualifications of teachers who had two year teaching certificates. Though Mr Mashangura's school was located in one of the old townships in the area, the school was well built from cement and bricks. The grounds were well taken care of and there was a security gate that was manned by a security guard. There was no laboratory in the school, but the teacher kept some apparatus in a small cupboard situated in front of the classroom.

4.3.1.3 Mr Zulu's context

Mr Zulu had been teaching Grade 7 natural sciences for the past 13 years in this school and was also a post level one teacher. Other than teaching NS to the Grade 7s in the school, he taught Technology and isiZulu in Grade 7. He had a total of 16 years teaching experience. Mr Zulu's highest qualification before enrolling for the ACE programme as a Senior Primary Teachers' Diploma (SPTD). Mr Zulu taught at a big school with a few prefabricated classrooms, but the majority of the classrooms were built from cement and bricks and the prefabricated ones were built from corrugated iron. The prefabricated classrooms were allocated to the Grade 7 learners, while the cement and brick classrooms were allocated to Grades R-6 learners. There was a computer laboratory in the school, but there was no science laboratory.

4.3.1.4 Ms Ntombela's context

Ms Ntombela was the only female teacher who participated in this study. She has been teaching for nine years in primary schools, and joined this school two years ago. Out of the nine years of teaching experience, five were spent teaching NS in Grade 7. Ms Ntombela's highest qualification before enrolling for the ACE programme was the SPTD. There was a laboratory in the school, but she was concerned that the laboratory was too far from the classrooms for her to use. It was observed that there was running water and electricity in the school. Her school was well resourced compared to the schools of the other three teachers in the study. There were computers and photocopying machines meant to enhance teaching and learning in Ms Ntombela's school. The biographical information of the teachers who participated in the study are summarised in Table 4.1.

Table 4.1: Biographical information of the participants in the study.

Teacher pseudonym	***Gender***	***Years teaching NS Grade 7***	***Total years of teaching experience***	***Highest Qualification before ACE***	***Post level of the teacher***
Mr Wakithi	M	11	12	SPTD	1
Mr Mashangura	M	22	22	FDE	1
Mr Zulu	M	13	16	SPTD	1
Ms Ntombela	F	5	9	SPTD	1

As already indicated, the four teachers in the study taught in schools located in previously disadvantaged communities in the province. The schools offered grades R to Grade 7. The details of the schools have been summarised in Table 4.2.

Table 4.2: The summary of the sampled schools' context

School	***Teacher***	***Location***	***Running Water***	***Electricity***	***Laboratory***
Waiting Primary School	Mr Wakithi	Farm school outside a small town	Yes	Yes	None
Mashaning Primary	Mr	Located in the old	Yes but	Yes	None

School	Mashangura	township	scarce		
Mngwenya Primary School	Mr Zulu	Located in a developing area with RDP houses	Yes	Yes	None
Ntonto Primary School	Ms Ntombela	Newly developed area with RDP houses	Yes	Yes	Yes

*RDP house means a Reconstruction and Development Programme house provided by the South African Government for the poor after 1994.

4.4 DATA COLLECTION

In qualitative research, as De Vos *et al.* (2005) put it " the exploration and description of the case takes place through detailed, in-depth data collection methods, involving multiple sources of information that are rich in context". Tessier (2012) also proposes that a combination of data collection methods be use in a qualitative study to improve the quality of data management. It is in this regard that the interviews, lesson observation and document analysis were used as data collection methods in this study.

These multiple data collection methods were used to explore the views of teachers on their classroom practice after completing the ACE NS programme and to probe to what extent the outcomes of the programme have been achieved. The use of three data collection methods in this study were used for triangulation purposes, and to create an opportunity to explore in-detail the four cases.

The document analysis was conducted in two ways. The first focused on the DoE and the ACE Service Provider's documents, which were sourced from the internet. The DoE documents were the Norms and Standards (DoE, 2000) and the NS RNCS Learning Area Statement (DoE, 2002). The ACE Service Provider's documents that were analysed were the course documents on the admission and outcomes of the ACE NS programme (Service Provider, 2013). These documents were read repeatedly to get an understanding of the envisaged goals of the ACE NS (a detailed discussion is presented in Chapter 5). Then, the second way of document analysis was conducted in schools to triangulate the data collected from the interviews and lesson observations. Learners' workbooks, as well as the teachers' documents and records were analysed.

In the schools, interviews were conducted first for each case, and then lesson observations, as well as document analysis, followed. This sequence of data collection was preferred so that some of the claims made during the interviews could be confirmed or disapproved through the lesson observations and document analysis. The interviews created an opportunity to collect data on the views of teachers on their classroom practices. The lesson observations and document analysis collected data on the actual classroom practice of science teachers.

Each school was visited seven times, where the first visit focused on the introduction of the study to the school. The ethical issues were discussed and permission letters signed. Learners received consent letters to be read and signed by their parents, these letters were collected in the second visit to the schools. Also, on the first visit the completion of the biographical information form with the school and teacher's background information was conducted. The remaining six visits concentrated on data collection. The second visit focused on collecting consent letters from parents, conducting interviews, as well as the first lesson observation for each teacher. The third, fourth, fifth, sixth and the seventh visits focused on further lesson observations and document analysis. The third, fourth, fifth sixth and the seventh visits also focused on the verification of the data collected during the previous visits. All in all, the data collection occurred over the course of 24 events for this study. The lesson observations and document analysis were conducted six times per teacher, starting from the second to the seventh visit. Data collection was completed within a fortnight per school. The visits were conducted from Monday through to Thursday in consultation with the teachers to avoid the risk of logistical problems on Fridays at the schools. The instruments used in the study are discussed below.

4.4.1 Interviews

The interviews were the first data collected, and were conducted to gain an in-depth understanding of the views and opinions of the teachers about their classroom practice after completing the ACE NS programme. This is in line with Denzin and Lincoln (2011), who suggest that the focus of interviews should be on gaining in-depth understanding of the views and opinions of the participants. Similarly, the interviews were focused conversations (Berg, 2001) about their views on their classroom practice after completing an ACE programme. Probing questions were used to draw more information from the teachers. However, probing was limited whenever the teachers seemed to struggle or were unwilling to respond, the aim of the interview was not to embarrass them. Each interview session lasted approximately for an hour. An interview protocol was used to guide the interview session with the teachers. A copy of the interview protocol is attached in this report as Appendix 3. The researcher did not interrupt the teachers while they were responding to the interview questions. However, where more information was required from an individual teacher for more detail, and for clarity purposes, follow up questions were asked. The questions in the interview protocol were open-ended questions, which implied that the teachers could choose what to say and decide how long their responses should be, as recommended by Denscombe (2003).

The interview protocol focused on the teachers' classroom practice and how the ACE programme contributed to develop their practices. All interviews were recorded and later transcribed. The interviews were recorded to ensure that no information as lost, as suggested by Silverman (2014). The transcriptions were read repeatedly to gain a deeper understanding of the responses given by the teachers, and was then later coded, as recommended by Elo and Kyngäs (2008).

4.4.2 Lesson observations

Lessons were observed to explore the teachers' actual classroom practice, focusing on the aspects of classroom practice discussed in the literature review. The researcher did not choose the lessons and time for lesson observations but the data collection period coincided with the third term. I noticed that teachers were behind the work schedule for the term. The timetable of each school was adhered to, avoiding disrupting the normal running of the school. So, as already pointed out in Section 4.2.3 there was no special arrangement made for lesson observations. As indicated earlier, the lesson observations were conducted after the interview sessions with the teachers, and were observed to capture all the elements of the lesson as reflected in the lesson observation schedule (Somekh & Lewin, 2006). The elements, as reflected in the lesson observation schedule, were the teachers' subject knowledge, practical competence in conducting experiments, pedagogical skills, language skills, and lastly, beliefs and attitudes about teaching science. Care was taken that the faces of the learners were not captured. As the lesson presentations were observed, the researcher did not interfere with the smooth running of the lessons and was quietly seated at the back of the classroom video recording the lessons. At the same time, the researcher was able to take observational notes, noting down other aspects of the lesson like learner reactions that were not captured with the video camera (Creswell, 2007). Both the learners' actions and teachers' actions were observed during lesson presentations. This was done to ensure that no information was lost in the process of data collection. The teachers' subject knowledge, practical competence in doing experiments, pedagogical skills, language skills, and beliefs and attitudes were observed as the lessons progressed.

4.4.3 Document analysis

The document analysis was conducted as the third method of data collection in the study. As indicated earlier, there were two forms of document analysis conducted. The first form of document analysis was conducted on the DoE's and the ACE Service Provider's documents. The purpose was to collect data related to the envisaged outcomes of the ACE programme. The second form of document analysis focused on the teachers' documents and records, as well as learners' workbooks. The mentioned documents were analysed as they related to the study and also served to confirm the evidence from other sources of collected data, as suggested by Maree (2007). Learners' workbooks were analysed to check if they were given some written work based on practical work, to check the accuracy of feedback given to learners, the frequency of learners' written work, to check whether the written work had activities that required higher order thinking, and to find out if the learners' activities indicated any evidence of different assessment activities. The teachers' documents and records were analysed to check if they had covered all the science content as prescribed in their planning, if the learners' assessment records revealed planning for various learning styles, and if there were recording sheets for learner performance. The second form of document analysis was conducted according to the document analysis guideline, as seen in Appendix 5.

4.5 DATA ANALYSIS

The current research is a qualitative study, thus a qualitative data analysis was followed. According to Denzin and Lincoln (2011), a qualitative data analysis is an ongoing and a non-linear process. Content analysis was used as a data analysis method. Kohlbacher (2006, p.17) explains as follows: "Content analysis can be viewed as a comprehensive approach to data analysis suitable for case study research, it contributes to adding and enhancing rigor, validity and reliability of case study research". It is for this reason that it was selected for the study. Also, the content analysis used was thematic, as the data was categorised into themes after being coded. As already indicated, the data collected was read repeatedly and open coding was done to break down and understand the text, which led to the grouping of data into categories, as suggested by Flick (2014). Consequently, the data was analysed as it was collected. In the event that clarity was needed, the researcher went back to the respondents the following day to verify and to close some gaps in the data collected, as proposed by Denscombe (2003). The summary of the process followed is illustrated in Figure 4.1.

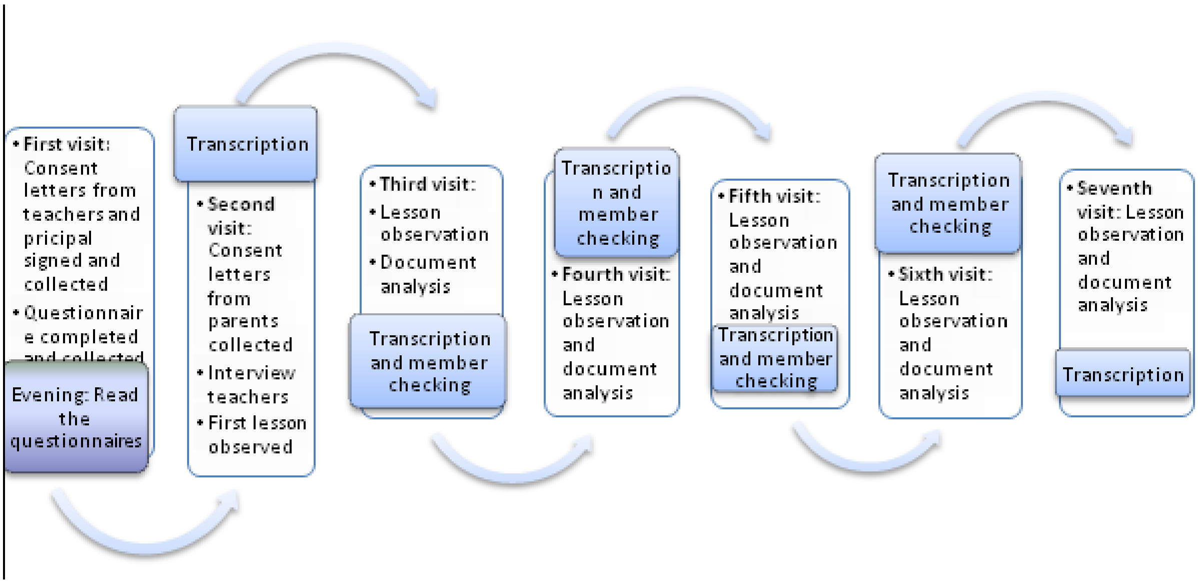


Figure 4.1: Illustration of how data was analysed as it was collected.

As indicated, the data collected from the four schools was transcribed the same evening it was collected while the researcher could still recall most of the information. However, it should be noted that the process of transcription for each lesson was not a once off event. De Vos *et al.* (2005) suggest that interviews be transcribed and analysed while one can still remember, this is what transpired in this study. The recorded data collected on each day was transcribed the same evening. The researcher listened to the recordings and conducted the transcription for that day, as suggested by Silverman (2014). As English was none of the teachers' first language, there were challenges related to understanding the pronunciation of some of the words used by different teachers. Consequently, the researcher had to listen to the recordings repeatedly before she could better understand the teachers' responses. The process involved member checking when the subsequent visit was carried out in each school.

As the data collection was concluded in each school, the recorded data was read again repeatedly to obtain a deeper understanding. Leedy and Ormrod (2005, p.133) state that "We collect numerous forms of data and examine them from various angles to construct a rich and meaningful picture of a complex, multifaceted situation". The repetitive reading of the transcripts allowed a better understanding of the data.

4.5.1 Organisation of the data

A large amount of data were collected using the three data collection methods and therefore needed to be well organised. The organisation of data was guided by the literature review and conceptual framework using the same categories and criteria as the instruments. Leedy and Ormrod (2005, p. 150) recommend to: "Go through the data several times" organising the data, reading and assigning categories. The data collected through the interviews and recordings were transcribed. Davidson (2009) views transcription as an important part of data analysis. The transcriptions were arranged in a table with five columns. The first column indicates the speaker, being either the researcher or the respondent. The second column reflects the spoken words, e.g. the actual questions asked and the responses, while the third column comprises a description of code. The fourth column constituted the codes attached to the transcribed data and the fifth column contained the comments made with regard to the transcribed data, Table 4.3 depicts part of the table based on one teacher's interview transcriptions.

Table 4.3: Part of a table for analysing one teacher's interview transcriptions.

	Interview Questions	***Description of code***	***Code***	***Researcher's comment***
Researcher	Do you believe that you have sufficient subject knowledge to teach natural sciences?			
Teacher	Yes, yes, yes, I do have ma'm.	Teacher's attitude Teacher confidence Subject knowledge	TA TC SK	He displayed over-confidence when he responded to this question with the 3 yeses.
Researcher	Can you give an example of subject knowledge in the syllabus? [the teacher was quiet] Maybe if there is something interesting or a topic that you are struggling to teach?			
Teacher	Aih, there is no there is no - there is no problem as far as everything is concern	Resource needs	RC	No subject knowledge

	in science, the only challenge that I have is experiment because here at our school we don't have a laboratory, otherwise the rest eh…eh	Teacher confidence	TC	was given except the challenge regarding experiments because of the lack of a laboratory.

As already indicated, the researcher listened to the recordings several times to verify the transcribed data, after which she read the data to familiarise herself with it, as proposed by Elo and Kyngäs (2008), and to get an overall impression of the content from the data (Henning *et al.*, 2004). This process enabled the researcher to streamline and organise the data according to the pre-determined and emergent categories and themes. The pre-determined themes came from the theoretical framework and the literature reviewed, through which one theme emerged from the data.

The data collected from the lesson observations were also organised in tabular form. Lessons that were video recorded and observational notes taken during the lesson observations were analysed. Each day in the evening, the recorded videos were transcribed and the lesson observation schedule was completed in a tabular template. The table was designed to have three columns where the first column indicates the elements of classroom practice, the second column indicates the question from the observation schedule, and the last column presents the interpretation of what was observed. Part of the table extracted from one teacher's lesson observation data is depicted in Table 4.4.

Table 4.4: Part of the data analysis for lesson observations for one of the teachers.

Elements of classroom practice to be observed	***Questions from observation schedule***	Comments
Teachers' subject knowledge	Is the content presented correctly?	The content on volcanic eruptions was not presented but learners were presenting demonstrations on erupting volcanos.
Teachers' practical competency in conducting experiments	Did the teacher select appropriate apparatus beforehand?	Appropriate resources were selected and prepared beforehand in this lesson. Learners were required a day before to prepare a hard part of the model of the volcano.

Demonstrating knowledge of learners	Were the learners assessed to find out if they had learnt something from the demonstration/experiment?	The teacher did not conduct a demonstration in this lesson.
	Is there continuous assessment?	Mr Zulu only assessed learners' demonstration by group of learners. He assessed the modelling of the erupting volcano.
	How is the classroom managed?	The classroom was well managed even though the lesson was conducted outside.

These tables were completed for each lesson observed. Later in the evening, the video recordings were listened to repeatedly to acquire an understanding of what was observed and to improve the transcription accordingly.

The school data collected through the document analysis was organised in a table according to the criteria set to guide document analysis. Part of the data collected through the document analysis for one of the teachers is depicted in Table 4.5.

Table 4.5: A part of the data analysis table for the teacher document analysis.

CRITERIA	Comments
Activities based on practical work; frequency of written work if any.	• There are activities based on practical work. • Learners have written work on each topic taught according to the work schedule. • In January, there were 11 examples of written work and on February 6.
Accuracy of feedback or corrections given to learners by the teacher.	• Corrections were reflected in the learners' workbooks. • Mr Zulu controlled the workbooks. • The feedback/corrections in the learners' workbooks were correct.
Activities in teacher planning that involve practical work.	• There were planned worksheets and activities for learners to do. • Work schedule reflected content where practical tasks could be done. • Lesson preparations reflected content where practical tasks could be done. • Programme of assessment contained projects, translations tasks and investigations where investigation could be a practical task.
Science content covered for the grade in the planning.	The planned activities reflected scientific content as per the work schedule that was supplied by the school.

As seen in Table 4.5, there were two columns. The first column indicated the criteria informing what the researcher should look for, and the second column indicated the researcher's comments on the identified criteria. On the whole, this is how the data collected using the multiple data collection methods was organised in this study.

4.5.2 Presentation and interpretation of data

The first set of data collection occurred through interviews. Interviews were conducted first to explore science teachers views about their classroom practice after completing an ACE programme, and to probe to what extent the outcomes of the programme have been achieved. Teachers were visited and interviewed in their own schools and the interviews were recorded, as suggested by Silverman (2014). The interview protocol used was developed against the background of the research questions, which were guided by the literature review and the theoretical framework of this study. The interview protocol is attached at the back of this thesis as Appendix 2.

Qualitative content analysis was conducted in this study and each case was analysed separately. The interview recordings were transcribed then the transcriptions were read repeatedly to acquire a better understanding of the data. Elo and Kyngäs (2008) clarify that reading the data repeatedly allows the researcher to be immersed in the data, creating an opportunity to make sense of and be familiar with the data. The data was then coded and the majority of the codes used came from the literature reviewed, the theoretical framework of the study, and a few emerged from the data. This is in partial agreement with Gibbs (2009, p.44), who explains that "The categories or concepts the codes represent may come from the research literature, previous studies, topics in the interview schedule, hunches you have about what is going on".

The codes were categorised into themes, namely, teacher's subject knowledge, laboratory work, pedagogical knowledge, learner outcomes, professional identity, and programme outcomes. These themes were predetermined from the literature review and theoretical framework of the study, except for one theme, laboratory work, that emerged from the data.

These themes were used as topics when presenting data analysed from the interviews. The themes, together with the corresponding categories and codes for this study, are depicted in Table 4.6

Table 4.6: Overview of the themes and categories

Themes	***Categories***	***Codes***
Teacher's subject knowledge	Teacher's subject knowledge	SK
Laboratory work	Practical skills	PS
	Resource needs	RN
	Improvisation	IMP
Pedagogical knowledge	Pedagogical skills	PS
	Understanding learners	UL
Learner outcomes	Learner outcomes	LO
Professional identity	Teacher’s belief	TB
	Teacher confidence	TC
	Teacher’s attitudes	TA
	Collaboration	C
Programme outcomes	Outcomes of the ACE programme	OAP

The second set of data was collected through lesson observations of the actual classroom practice of the participating teachers. This data was collected to confirm or disprove what the teachers had stated in the interviews. The data was collected by visiting teachers in their own classrooms and observing lessons, as the classroom was considered their natural environment (Creswell, 2007). Six lessons of each teacher were observed, however, actual teaching did not occur in all the lessons. The researcher did not want to observe one lesson per teacher because in one lesson, teachers might only present their best lesson and the researcher may not get a true reflection of their actual classroom practices. All the lessons were recorded so that no important information was overlooked during the lesson observations. A lesson observation schedule was completed and later in the evening it was refined while the researcher could still remember what had transpired and how each lesson unfolded. The development of the lesson observation schedule was guided by the research questions and the literature reviewed, focusing on the elements of classroom practice. The observation schedule focused on the elements: teacher's subject knowledge, practical competence in conducting experiments, pedagogical skills, language skills, and lastly, the beliefs and attitudes of teachers about teaching science. These elements have been used as topics when presenting the data collected from the lesson observations.

The third set of data was collected by analysing different documents. As already indicated, this document analysis focused on the teachers' documents and records, as well as the learners' workbooks. The document analysis guide was separated into Guide 1 and Guide 2. The document analysis of Guide 1 contained the criteria pertaining to the learners' workbooks, and Guide 2 contained elements relating to the teachers' planning documents, which comprise a work schedule, lesson preparation, and programme of assessment. The document analysis guide is attached at the back of this thesis as Appendix 5. Three learners' workbooks and the teachers' file were requested from the teachers after each and every lesson that was observed. The learners' workbooks were analysed to confirm whether the tasks planned by the teachers permeated the learners' workbooks. This was done by firstly confirming if there were any activities in the learners' workbooks based on practical activities. Secondly, this was done to find how frequently learners were given written work. Thirdly, this was carried out to verify the accuracy of the feedback given to learners because the accuracy of feedback that a teacher gives to learners could be linked to the subject knowledge of teachers. Fourthly, the learners' workbooks were analysed to confirm if there were any activities that required higher order thinking in the learners' workbooks. Lastly, this was done to observe whether there was any evidence of various types of assessment given to the learners. These elements were used as criteria for the analysis of the learners' workbooks, and were later utilised as topics when presenting the data collected from the analysis of the learners' workbooks.

The teachers' files were analysed and focused on the work schedule, lesson preparations and the programme of assessment. These teachers' documents and records were analysed to confirm if there was any planning in the teacher's file that involved practical work, to confirm whether the teacher's planning addresses the scientific content for the grade, whether there were learners' assessment records planned by the teacher to accommodate various learning styles, the spread of learner performance, as well as to observe if learners were assessed regularly. These elements were used as topics in presenting the data from the analysis of the teachers' documents and records.

It was indicated already that this research was a qualitative study where a multi-case study design was used. The data collected in this study was large, therefore, it was analysed in an organised manner. This is in agreement with Flick (2014), who suggests that before data is analysed, it should be prepared and organised. Therefore, in this study the data was prepared, organised, analysed and presented according to each case study.

The data collected through the interviews were presented according to the interview protocol's main elements. Moreover, the data collected through the lesson observations were presented using the headings of the main elements of the observation schedule. Then, the criteria of the document analysis guide were used to present the data collected through the document analysis. The main elements of the interview protocols used were the teachers' subject knowledge, laboratory work, pedagogical knowledge, learner outcomes, programme outcomes, and professional identity. The interview protocol is attached in this thesis as Appendix 3. The main elements of the observation schedule were subject knowledge, practical competence in conducting experiments, pedagogical skills, language skills, as well as teacher's beliefs and attitudes. The observation schedule is attached in this thesis as Appendix 4. The criteria in the teachers' document analysis guide were activities in teacher planning that involve practical work, scientific content covered for the grade, learners' assessment records planned for various learning styles, and recording sheets for learner performance. In addition, the criteria in the learners' document analysis guide were activities based on practical work, accuracy of feedback given to learners by the teacher, activities that required higher order thinking, and evidence of different assessment activities given to the learners. As already indicated, the document analysis guide is attached in this thesis as Appendix 5. The presentation and analysis of the data from the DoE and the ACE Service Provider's documents focused on the goals of the ACE NS programme, as outlined in the documents.

When presenting the data collected through interviews, quotations of the participants' words were used to provide evidence of their different perspectives, as recommended by Creswell (2007). In some cases, the meaning of the quotations had to be understood taking into account that the respondents were not English first language speakers. The teachers did not answer all the interview questions as anticipated, and in these cases, their responses were coded according to a different category according to the meaning communicated. There were also instances where they gave vague answers, which were not probed in order to not upset and embarrass the teachers by asking what they did not want to answer.

4.6 TRUSTWORTHINESS OF THE STUDY

The design of this study enhanced trustworthiness. Guba (1981) cites credibility, transferability, dependability and confirmability as aspects of trustworthiness in qualitative studies. He further explains that there are actions to be implemented that lead to credibility, transferability, dependability and conformability. The manner in which these actions were implemented in the current study is discussed below.

Credibility

Prolonged engagement in the field, persistent observation, peer debriefing and member checking are actions that lead to credibility, as suggested by Guba (1981). Although in this study, where not all these actions were possible, prolonged engagement, persistent observation and member checking were incorporated. Teachers were visited seven times in their schools, of which lessons were observed six times, ensuring prolonged engagement.

Member checking was done in the successive visit to the school to verify the data collected in the previous visit. All interviews were recorded then transcriptions were done. The verification of the transcribed data of the teachers' interviews improved the credibility of data in the study.

Transferability

Collecting rich descriptive data and purposeful sampling were viewed as actions leading to transferability, according to Guba (1981). These two actions were included when the researcher interacted with the teachers during the interviews, for lesson observations and for document analysis. Furthermore, sampling in this study, as already indicated in Section 4.3, was purposefully done to ensure rich descriptive data. Babbie and Mouton (2010, p.277) maintain that, "Transferability refers to the extent to which the findings can be applied in other contexts". Since this was a case study with a small sample, the findings were not meant to be generalised to the larger population of teachers, but rather the insight generated can be applied to cases of similar nature. This implies that the findings of this study can be transferred to other teachers who have completed the ACE NS programme with the same ACE Service Provider as the teachers who participated in the study.

Dependability

The use of overlapping methods leads to dependability. Silverman (2014) finds that when researchers look at an object from more than one perspective, they get comprehensive knowledge about the object under study. Multiple data collection methods were used to understand the teachers' classroom practice after completing an ACE programme from more than one perspective (Creswell, 2007). This allowed for comprehensive knowledge gathered about the views of the teachers on their classroom practice and the achievement of the programme outcomes. Therefore, the use of three data collection methods in this study was attempted to ensure dependability.

Confirmability

Triangulation is associated with an action that results in confirmability, according to Guba (1981). Furthermore, the multiple sources of information gathered were meant to improve the validity of the current study. In general, trustworthiness in the current study was enhanced by taking care with the credibility, transferability, dependability and confirmability thereof, as discussed.

4.7 ETHICAL CONSIDERATIONS

Creswell (2014) suggests that the possible ethical issues that might arise in a study should be anticipated and planned for accordingly. It is in this regard that the ethical issues were considered and planned for in this study. Ethical clearance was requested from the University of Pretoria before the commencement of data collection. Mitchell and Jolley (2001) explain that permission must be acquired from the authorities before conducting a study. Permission was also requested from the province where the study was conducted after receiving the ethical clearance. The districts were further visited and were informed about the permission received from the provincial office. The researcher was given permission to visit the schools, after which the schools were contacted telephonically to secure appointments to visit them. The principals of the schools were informed about the study and the aim was communicated to them. The principals were invited to give informed consent by reading and signing the permission letters. Informed consent, as Silverman (2014) suggests, is the best route for negotiating a request to conduct a study. Teachers were also invited to complete the permission letters. On the same day, the learners were given permission letters to be completed and signed by their parents. The purpose of the study was indicated and it was clarified in the permission letters that participation in the study was voluntary. It was emphasised that the schools and parents should not feel obliged to participate in the study. This is in line with what McBarney (2001, p.68), who clarifies that, "Researchers should respect the right of privacy of their participants and be careful about the possibility of coercion".

The names of the schools, the teachers and the ACE Service Provider were not revealed to adhere to confidentiality. All respondents were assured of anonymity, which was maintained through the use of pseudonyms so that respondents and their schools could not be identified. The real names of the respondents were not even used in the transcription of the data. All the data collected and the video recordings were stored securely on the researcher's laptop in a password protected drive, and later submitted to the university after the completion of the study. This is in agreement with Bless, Higson,-Smith and Sithole (2013). All of the respondents were informed that they could withdraw from the study at any time should they wish to do so without being penalised. In addition, the respondents were made aware that there were no monetary incentives for participating in the study. However, the results of the study were to be available to the schools as published articles in journals.

To ensure voluntary participation, the sample was not drawn from the province where the researcher is employed, as power relations could have interfered with the ethics of the research. By drawing the sample from a different province, it was argued that the study might obtain genuine responses from the respondents. Also, Bless, Higson-Smith and Sithole (2013) argue that participants should be protected from emotional harm. If the study was conducted in the province where the researcher worked, the participating teachers could be anxious and think that data collected would be used to evaluate them and their schools. It is argued that the views of science teachers on their classroom practice after completing an ACE programme and the achievement of the programme outcomes may be independent of the province if the same ACE Service Providers have been used in all of the provinces in South Africa.

4.8 CONCLUSION

This chapter has outlined how the study was designed and conducted. The qualitative nature of the research was discussed, as well as the case study design, which was found to be most appropriate to answer the research question. Data were collected, organised and interpreted in the light of the reviewed literature, as well as the theoretical framework for the study. Sampling was done after receiving permission from the university to conduct the study. Four teachers from schools located in previously disadvantaged communities were the respondents in this study. Ethical issues were considered because this study involved people. It was ensured, as discussed, that all of the respondents were not harmed, they were respected and they voluntarily participated in the study.

Three data collection methods were employed for the triangulation of the data and, consequently, to ensure the trustworthiness of the study. The qualitative data analysis was conducted where recorded data was transcribed and coded. As indicated, the data was organised using pre-determined themes from the literature reviewed and the theoretical framework. One theme emerged from the data, which was organised and presented using the elements and criteria as reflected in the instruments that were used to collect the data. Chapter 5 will discuss the results of the document analysis of the DoE and the Service Provider to understand the envisaged outcomes of the ACE programme.

CHAPTER 5 : FINDINGS: ENVISAGED OUTCOMES

5.1 INTRODUCTION

Chapter 4 discussed the research design for the study and this chapter presents the analysis of the envisaged outcomes of the ACE programme. The main question for this study was: How do the teachers view their classroom practice after completing an ACE programme, and to what extent have the outcomes of the programme been achieved? In answering the main research question, five research sub-questions were formulated. The first research sub question reads: What are the outcomes envisaged by the ACE programme? The document analysis presented in this chapter sought to address this research sub-question. Documents from the Service Provider of the ACE programme and from the DoE were analysed.

In Section 5.2, the outcomes of the ACE programme envisaged by the DoE are discussed, followed by the outcomes envisaged by the Service Provider, which are discussed in Section 5.3. In Section 5.4, the alignment between the documents of the Service Provider and the DoE are discussed. Finally, Section 5.5 concludes this chapter. A diagrammatical outline of this chapter is depicted in Figure 5.1.

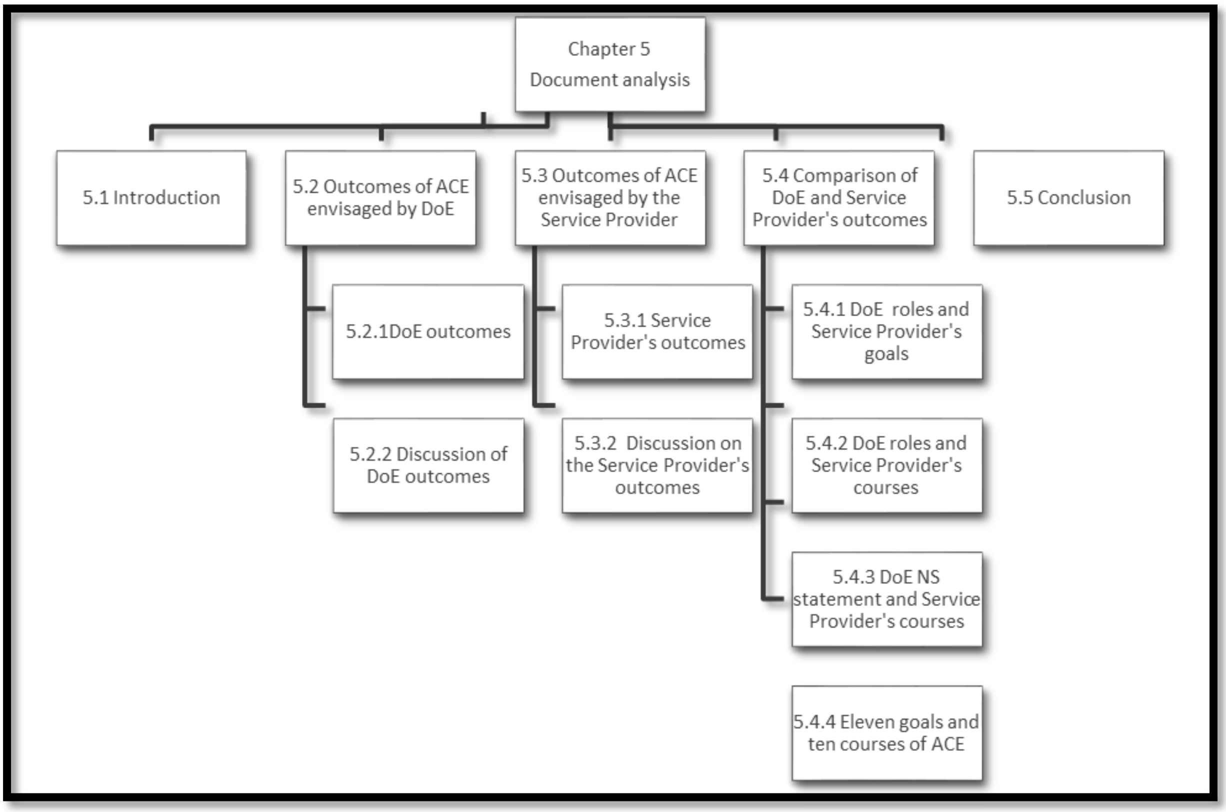


Figure 5.1: Diagrammatical outline of chapter 5

5.2 THE OUTCOMES OF THE ACE PROGRAMME ENVISAGED BY THE DOE

It was mentioned in Chapter 2 (Section 2.4) that when the National Teacher Audit (NTA) was conducted between 1993 and 1994, it revealed a number of challenges in teacher education in South Africa. One of the findings of the audit was that some teachers were unqualified, while others were under-qualified in the subject they were teaching (Joint Education Trust, 1995). The DoE has conceptualised a means of improving the qualifications of both the unqualified and the under-qualified teachers. It is for this reason that in 1995 a task team was appointed to develop Norms and Standards for teacher education (Pretorius & Lemmer, 1998). The work of the task team culminated in the Norms and Standards for Educators (DoE, 2000). It should be noted that the Norms and Standards for Educators has been replaced by a new policy, namely, 'The minimum requirement for teacher education' (Department of Higher Education And Training, 2011, p.7). Before the introduction of ACE, teachers who had two-year qualifications enrolled for qualifications like a Further Diploma in Education (FDE) and a Higher Diploma in Education (HDE) in an attempt to improve their qualifications. "The FDE was introduced in the late 1980s and early 1990s by the old distance college of education as a way of upgrading teachers to m+4 status […] In the post-apartheid period, the state initiated a major process of reform in its quest to achieve equity in education" (Council on Higher Education, 2010, p.106). This statement emphasises that an FDE was one of the qualifications introduced by the DoE to meet the challenge of under-qualified and unqualified teachers in South Africa. With the introduction of the Norms and Standards for Educators, an FDE was converted to ACE (Council on Higher Education, 2010). The key objectives of the ACE programme in the Council on Higher Education document were stated as:

- Re-skilling teachers who are unqualified or under-qualified in specific subjects;
- The development of skills in specific learning areas that are newly introduced in the NCS;
- An upgrade opportunity for teachers with a three-year teaching qualification; and
- The provision of vertical access to higher level qualifications such as a BEd(Hons) (Council on Higher Education, 2010, p.107).

According to the analysis, the first objective concerns teachers who needed to change their specialisation due to the introduction of Outcomes-Based Education (OBE), which rendered some subjects insufficient, for example, in the Senior Phase, the subject of Religious Education was discontinued and teachers who taught this subject prior to 2002 were to be re-skilled. They were indirectly compelled by the education system to change specialisations because the subjects they taught no longer existed (DoE, 2002). Therefore, in such cases, the introduction of the ACE programme provided an opportunity for teachers to change their area of expertise.

The second objective addresses the development of teachers' skills and competences in the Learning Areas that were introduced with the NCS document. The introduction of NS as a Learning Area left most teachers with content gaps to be taught in NS. According to the NCS, NS comprises of the Life and Living knowledge area, which is better known to life sciences experts; the Matter and Materials as well as Energy and Change knowledge areas which suit the Physical Sciences experts and lastly, the Planet Earth and Beyond knowledge area which required teachers who have specialized in Astronomy and Earth Sciences (DoE, 2002).

During the introduction of NS, most teachers were not trained to teach all four of the NS content areas. It was common that physical sciences teachers who specialised in physics and chemistry were also required to teach NS. Sometimes, NS teachers were life sciences specialists who had not specialised in the other NS content areas. It was in this regard that the NS teachers were required to improve their skills and competencies to become specialists in all four knowledge areas in NS. Hence, the second objective, as stated by the Council on Higher Education (2010), is appropriate.

There is a slight difference between the third and the fourth objective. The third objective focused on affording teachers a three-year teaching qualification opportunity to upgrade from REQV 13 to REQV 14. Objective four addresses the provision of vertical access to higher-level teacher qualifications. Teachers who had a three-year or lesser teacher qualification were regarded as under-qualified as from 2002; hence, they were expected to upgrade their qualifications to four years (DoE, 2000). Therefore, the ACE programme provided an opportunity for teachers to upgrade and to gain access to higher qualifications. In fact, the fourth outcome indicates that teachers who have completed the ACE programme qualify to be enrolled for a BEd (Honours) degree (DoE, 2000). The Council on Higher Education

(2010) document thus gave an explanation of the two goals of ACE, as spelt out in the Norms and Standards for Educators (DoE, 2000) and resulted in four objectives, as discussed.

5.2.1 The DoE envisaged outcomes of the ACE programme

When the Norms and Standards for Educators (DoE, 2000) document was examined to obtain the outcomes of the ACE programme envisaged by the DoE, it was found that this policy document does not specify the outcomes for the ACE programme, but rather generally indicates that the goals of the ACE programme are to upgrade and to re-skill teachers. Furthermore, the document clearly indicates that the seven roles of educators should be considered when developing programmes for teachers: “Qualifications must be designed around the specialist role as this shapes the other six roles and their applied competence” (DoE, 2000, p.12). The seven roles as listed in the policy are:

- Being a subject/phase specialist;
- Being a learning mediator;
- Being an interpreter and designer of learning programmes and material;
- Being a leader, administrator, and manager;
- Being part of a community, fulfilling citizenship and a pastoral role;
- Being a scholar, researcher, and lifelong learner; and
- Being an assessor.

These roles were applicable to all Learning Areas. The role of a Learning Area specialist is regarded as the primary role. The other six educator roles are not generic, but should be designed around the Learning Area, for example, the NS teacher specialist role should focus on teaching science, and the other six roles should be within the context of teaching science.

It has been argued that some teachers will not be able to fulfill all of these roles at once. This perspective comes from Harden and Crosby (2000), who produced a guide on the roles of a teacher in the United Kingdom. They recommend that schools should conduct an audit of the roles that teachers currently hold. Subsequently, this audit could enable schools to plan for future employment and to focus on missing roles when recruiting new teachers. They suggest that an option should be explored first to see if the present members of staff cannot be trained to fulfill the missing roles before recruiting. However, it may still be possible for teachers to acquire all seven roles after completing the ACE programme. There are three competencies that are associated with the seven roles, with one allocated to each role (DoE, 2000, p.14):

- Practical competence, which entails the ability to do something;
- Foundational competence, which entails why a person does things; and
- Reflexive competence, which concerns evaluating and changing one's practice.

These three competencies were also interpreted in the Council on Higher Education (CHE) report on the National Review of Academic and Professional Programmes in Education (CHE, 2010):

> With regard to the practical competences, the student is expected to demonstrate the ability to consider a range of possibilities and choose the appropriate one to perform an action.
>
> With regard to the foundational competences, the student is expected to demonstrate an understanding of the knowledge and thinking, which underpins the actions taken.
>
> Reflexive competences follow from the other two competences, this competence requires the student to show the ability to integrate performances and decision-making with understanding (p.107).

5.2.2 Expectations of the DoE for teachers within an ACE programme

The roles of educators, together with the associated competencies, were also analysed in the context of this study, as guided by the theoretical framework. The theoretical framework indicates four domains associated with the professional growth of a teacher, namely, the external domain, domain of practice, personal domain and the domain of consequence (Clarke & Hollingsworth, 2002). It has already been indicated that the design of learning programmes should be informed by these seven roles, and therefore, the information acquired by teachers in the external domain should prepare them to execute these seven roles in the domain of practice. The execution of each of these roles in their classroom practice should be demonstrated by the three competencies discussed above. The demonstration of these competencies could potentially be observed in the classroom.

The three competencies associated with the seven roles of educators

In the domain of practice, the fulfilment of the seven roles of educators may be evident when the practical, foundational and reflexive competencies are demonstrated. The example of lesson preparations is used to discuss how the three competencies could be demonstrated by teachers. The first one, which is practical competence, can be demonstrated when teachers select the most appropriate learning activities to accommodate the different learning styles of the learners during lesson preparation. The selection can come from any source available to teachers, which could include textbooks, study guides, or internet for those with access to the internet. Teachers who engage in the activity of lesson preparation could demonstrate a foundational competence, which manifests when they do not struggle with content knowledge during lesson preparations. Reflexive competence may be evident when teachers think and consider the teaching strategies that they utilised previously in teaching a particular topic. They could think about how that strategy can be improved to enhance learning.

It was found in the literature that teachers' beliefs and attitude affect the decisions they make about their classroom practice (Beijaard *et al.*, 2004). This suggests that these competences demonstrated in the domain of practice are influenced by teachers' professional identity, located in the personal domain, as illustrated in the theoretical framework (Clarke & Hollingsworth, 2002). If the lesson preparations are properly done, teachers will be able to execute the prepared lessons with confidence in the classroom, and learners might become more interested in the science lesson, which could change their attitudes, behaviour and performance located in the domain of consequence.

Discussion of the seven roles of educators

The **first role** of being a Learning Area specialist is the main role on which the other roles are based, as suggested in the Norms and Standards for Educators (DoE, 2000). As indicated earlier, lesson preparation and presentation could pose a challenge when a teacher is not a Learning Area specialist. In addition, teachers may not be able to fulfill the other roles with ease unless they are Learning Area specialists.

The **second role** of being a learning mediator could enable teachers to recognise when learners do not understand what they are taught, and then change their teaching strategies and methods to suit the learners better. Sometimes, teachers may use a variety of teaching strategies to inspire and motivate learners to learn science. Such teaching strategies could include the use of discrepant events to teach science, as well as the use of constructivist teaching and learning principles to facilitate learning in the science classroom (Longfield, 2009; Richardson, 2003; Savasci, 2006).

The **third role** of being an interpreter and designer of learning programmes and material could be observed when teachers prepare lessons and resources to facilitate learning. The resources in the science classroom could range from handouts to the apparatus and chemicals required to conduct experiments.

The **fourth role** of being leaders, administrators and managers could be observed in the classroom in teachers providing leadership and good classroom management. The enactment of this role could be evident in the management of curriculum, learning activities, as well as resources. Teachers could take leadership in cases when changes in curriculum are made in the subjects they teach. They should be active, as opposed to being passive participants in curriculum development and change. They can become active participants by noting the gaps as they encounter them during the implementation of the curriculum, which would enable them to discuss the identified gaps when curriculum reviews are implemented. Teachers with improved professional identity should be the first to submit the shortcomings they have found in a curriculum review. It was found that teachers do not always assume leadership roles, as anticipated, for example, Urbanski and Nickolaou (1995) argue that teachers in general do not assume leadership roles in schools because they cannot distinguish between leadership and management. They further posit that principals' leadership should focus on providing opportunities for teachers to function maximally as leaders. Teachers should provide leadership with regard to the learning activities to be learnt, and which teaching strategy to apply in facilitating learning. These authors further find that teachers are accustomed to a protocol where the principal always has the last word in decision-making.

The **fifth role** of fulfilling a community, citizenship and pastoral role could be enacted by teachers through their interaction with community members and parents in upholding the values of democracy in their knowledge of scientific issues. As indicated in the Norms and Standard for Educators (DoE, 2000, p.14) document, "One critical dimension of this role is HIV/AIDS education", teachers could therefore participate of their own accord in community projects that aim to raise awareness on the issue of HIV/AIDS, as well as other community projects that raise awareness on environmental issues. Teachers could provide academic and personal support to learners in need of 'pastoral care' in the school.

The **sixth role** of being a scholar, researcher and lifelong learner could be assumed in two ways, namely, formally and informally. Informally, teachers can further develop themselves by reading electronic media, newspapers, magazine, articles or any books accessible to them, which could enhance their knowledge of science and practice of teaching science. In addition, teachers could prepare lessons by searching for information from textbooks, the internet, as well as other resources in fulfilling this role. Formally, being scholars, researchers and lifelong learners could suggest teachers enrolling in Institutions of Higher learning, like universities.

As discussed in Chapter 2, teachers should guard against enrolling in formal learning only to increase their REQV (Section 2.4), but are encouraged to enroll to improve their specialisation in the subject they teach. When teachers continue to study, they may become aware of their own deficiencies and their needs as Learning Area specialists. The awareness of their own needs may then motivate them to study further in their area of specialisation.

The **seventh role** of being an assessor should always be visible in teachers' classroom practice because this role cannot be separated from teaching and learning. Assessment is an integral part of teaching and learning (DoE, 2000; Department of Higher Education And Training, 2011). As teaching and learning progress, teachers are expected to assess whether the learners understand what is taught. This could be done through oral questioning or giving learners written work. The teacher could also assume the role of an assessor when discussing written tasks like homework and classwork. Teachers are also expected to fulfill this role in developing summative assessments.

It is acknowledged that not all teachers may be able to fulfill all of the seven roles immediately after completing the ACE programme. However, they may begin to fulfil these roles as they acquire teaching experience. This therefore suggests that teachers should not be dissatisfied with their work if they are unable to demonstrate all the competences associated with the fulfillment of the seven roles, but rather, while acquiring teaching experiences, there could be alternatives provided in the teaching profession to allow for professional growth.

On the whole, the DoE envisaged outcomes of the ACE programme were to produce teachers who fulfill the seven roles of educators in the classroom, and who, through the fulfilment of these roles, can demonstrate the three competencies, namely, practical, foundational and reflexive competences. Teachers should take ownership and responsibility for their classroom practices and professional development. Should a teacher be still be found lacking in this regard, involvement in collaborative activities like subject meetings where cluster of schools meet and discuss Learning Area best practices, or participation in a PLC must be considered. It was found that the involvement of teachers in PLC activities improves teachers' classroom practice, yielding a positive impact on learner performance (Stoll, Bolam, McMahon, Wallace & Thomas, 2006). These authors conclude that teacher professional development that utilises the strength of the individual teacher for the learning of the group has an impact on learner outcomes. However, providing further support to a teacher after the ACE programme is a new problem that lies beyond the scope of this study.

5.3 OUTCOMES ENVISAGED BY THE SERVICE PROVIDER OF THE ACE PROGRAMME

Having discussed the analysis of data from the DoE documents, a discussion on the data analysis from the Service Provider's documents is now presented. The Service Provider's documents were sourced from the internet and from a library. The ACE (Science) GET, as it is referred to in the Service Provider's documents, should be completed over two years part-time. This programme is aimed at NQF exit level 6, and has 120 SAQA credits.

5.3.1 The Service Provider envisaged outcomes with the ACE programme

The exit level outcomes, as reflected in the 2013 prospectus of the Service Provider, which are also listed in Appendix 5, are discussed in this paragraph (Service Provider, 2013). The Service Provider's envisaged outcomes are referred to as the exit level outcomes in the documents. Vorwerk (2005, p.4) defines exit level outcomes as the "outcomes to be achieved by a qualifying learner at the point at which he or she leaves the programme leading to a qualification". The exit level outcomes, as indicated in the Service Provider's documents, are the "goals of the ACE programme". In the case of the ACE programme, the learner is the teacher, because only in-service teachers who were qualified enrolled for the ACE programme. The exit level outcomes of the ACE programme, which are the 11 goals of ACE, were classified in terms of the theoretical framework and later compared to the outcomes envisaged by the DoE. The classification is depicted in Table 5.1 and the comparison is indicated in Table 5.3. These 11 goals are to:

- Competently apply the knowledge, skills, values, principles, methods and procedures relevant to their subject, learning area or specialism;

- Continue to broaden and deepen their knowledge of content, skills, values and ways of thinking in their subject, learning area or specialism, in ways that promote their teaching and their learners' learning;
- Continue to develop their pedagogical content knowledge and skills to provide a foundation for their teaching;
- Understand principles underlying the curriculum and curriculum change and how knowledge is selected for the curriculum;
- See links between theory and practice and use theory as a tool to understand, think about and solve problems in their school/workplace and within broader educational and community contexts;
- Engage in classroom and school/workplace-based research;
- Reflect on cultural, social, political and economic issues in relation to subject content and barriers to learning;
- Communicate effectively in visual, written or alternative modes in the classroom, community and in their academic studies;
- Be able to extend their academic literacy in further study through understanding and using effective study methods, including accessing libraries and using a range of appropriate technology;
- Understand career paths in education and take a leadership role in enabling and fostering collegial and co-operative ways of working among educators; and
- Take initiative in and responsibility for themselves, their work, communities and the broader natural and social environment (Service Provider, 2013).

5.3.2 The eleven goals of the ACE programme

The theoretical framework of this study (Clarke & Hollingsworth, 2002) was used to structure the discussion of the analysis of these eleven goals. As indicated in Section 5.2, the theoretical framework has four segments, which are referred to as domains. These domains are interconnected and, according to the model, change can be initiated at any of the four domains. The four domains are the external domain; domain of practice; personal domain; and domain of consequence (Clarke & Hollingsworth, 2002).

The 11 goals of ACE from the Service Provider have been organised according to these domains, as seen in Table 5.1. A discussion on what has informed these categories is provided in this section.

Table 5.1: The eleven goals of the ACE programme categorised according to the theoretical framework of this study

Domains	*The envisaged goals of the ACE programme from the Service Provider*
Domain of practice	**Goal 1**: Competently apply the knowledge, skills, values, principles, methods and procedures relevant to their subject, learning area or specialism;
	Goal 4: Understand principles underlying the curriculum and curriculum change and how knowledge is selected for the curriculum;
	Goal 8: Communicate effectively in visual, written or alternative modes in the classroom, community and in their academic study.
Personal Domain	**Goal 3**: Continue to develop their pedagogical content knowledge and skills to provide a foundation for their teaching;
	Goal 7: Reflect on cultural, social, political and economic issues in relation to subject content and barriers to learning;
	Goal 9: Be able to extend their academic literacy in further study through understanding and using effective study methods, including accessing libraries and using a range of appropriate technology;
Domain of Consequence	**Goal 2**: Continue to broaden and deepen their knowledge of content, skills, values and ways of thinking in their subject, learning area or specialism, in ways that promote their teaching and their learners' learning;
External domain	**Goal 5**: See links between theory and practice and use theory as a tool to understand, think about and solve problems in their school/workplace and within broader educational and community contexts;
	Goal 6: Engage in classroom and school/workplace-based research;
	Goal 10: Understand career paths in education and take a leadership role in enabling and fostering collegial and co-operative ways of working among educators;

	Goal 11: Take initiative in and responsibility for themselves, their work, communities and the broader natural and social environment.

Goals 1, 4 and 8, as seen in Table 5.1, were categorised under the domain of practice. Goal 1 indicates that 'the qualified practitioners at this level will apply competently the knowledge, skills, values, principles, methods and procedures relevant to their subject' (Service Provider, 2013, p105). This goal refers to the subject knowledge and the pedagogical content knowledge. One may conclude that teachers who have completed the ACE programme should not only have subject knowledge, but they should be able to apply this knowledge when teaching learners. Skills may include pedagogical skills, language skills and classroom management skills, as discussed in Chapter 2 (Section 2.5.4). The values that this goal refers to could include values like respecting the environment and protecting the environment. With respect to NS, a science teacher should be able to use resources sparingly. When teachers conduct experiments, for example, little amount of chemicals could be used where appropriate. Moreover, the discarding of chemicals should be done in a responsible way that considers the environment. The disposal of waste from the laboratory should be executed such that the environment is not harmed.

The latter part of goal 1 indicates that teachers should be able to apply principles, methods and procedures relevant to science. Principles that teachers could apply are the constructivist principle and the use of discrepant events in teaching science, as discussed in Chapter 2 (Section 2.5.4). Upon completing the ACE programme, teachers should be able to apply the teaching strategies and methods taught in the programme. Teaching strategies could include teaching the whole class using direct instruction as an approach, peer learning where a teacher allows learners to discuss in groups, and requesting learners to perform activities in groups. The achievement of this goal after completing the ACE programme may be observed, for example, in the teacher allowing learners to conduct practical work and practical demonstrations.

Goal 4 focuses on teachers' understanding of the fundamental principles of the curriculum, curriculum change, and how knowledge is selected for the curriculum. The principles underlying the NCS in South Africa include: social justice, a healthy environment, human rights and inclusivity; outcomes-based education; a high level of skills and knowledge for all; clarity and accessibility, as well as progression and integration (DoE, 2002).

The achievement of this goal should be reflected in teachers' classroom practice. Teachers are expected to accommodate these principles during teaching and assessment. Furthermore, the achievement of this goal could be seen in teachers' accommodation of these principles when they design and select learning activities.

Goal 8 concerns teachers being able to communicate effectively in visual, written or alternative modes in the classroom, community and in their academic studies (Service Provider, 2013). The achievement of this goal could be demonstrated in teachers use teaching aids to accommodate learners who struggle to understand abstract scientific concepts. Teachers could use pictures, models and simulations to explain these concepts. Overall, the achievement of the three goals, namely, goals 1, 4 and 8, could potentially be observed in teachers' classroom practice, which falls under the domain of practice according to the theoretical framework (Clarke & Hollingsworth, 2002).

Goals 3, 7 and 9, as seen in Table 5.1, have been grouped together under the personal domain. These three goals comprise the professional identity of teachers, more specifically, the beliefs they hold about themselves as science teachers. These goals focus on the knowledge and attitudes of science teachers. Upon the completion of the ACE programme, their confidence in themselves as science teachers is expected to increase, hence their professional identity is expected to be enhanced. The new knowledge acquired will enhance their confidence and consequentially, their view of themselves as science teachers. This is in accordance with the theoretical framework of this study, which shows that teacher professional development leads to the improved knowledge, belief and attitudes of teachers (Clarke & Hollingsworth, 2002).

Goal 7 anticipates that teachers will not only focus on teaching science in isolation, but rather incorporate other social, political and economical issues, as depicted in Table 5.1. The achievement of this goal is observable in teachers' ability to integrate these issues into teaching, as well as in designing learning activities, or selecting them from a textbook. For example, when learners are requested to bring resources from home to conduct practical work, teachers should consider that not all learners will be able to bring resources due to their socio-economic status. Some learners will not bring resources as required because there is nothing to bring from home. In such instances, teachers are expected to be sensitive and accommodate those learners who could not bring anything to school.

Goal 9 addresses the issue of teachers as life-long learners who are able to search and access information. They should search and update information in the pursuit of being better teachers in their subject, which could also increase their confidence and belief in themselves as science teachers. Teachers may even consider furthering their formal studies in their subject. It is acknowledged that once teachers have acquired the skill to search for information, they are capable of searching independently and informally when preparing lessons.

The fourth domain in the theoretical framework of this study is the domain of consequence. Goal 2, as seen in Table 5.1, is the only goal that relates to the domain of consequence regarding learners' outcomes. As already indicated, learners' outcomes could include their behaviour, attitudes and performance. The first part of goal 2 indicates that teachers should be able to continue furthering their knowledge in the subject to enhance their teaching, and ultimately their learners' learning. Although it can be argued that teachers' furthering of their studies falls under the personal domain category, the domain of consequence could also include the outcomes of completing the ACE programme, as observed in teachers' classroom practice, as well as in the improved professional identity of teachers. However, in the theoretical framework adopted for this study, the domain of consequence refers to learner outcomes. Therefore, goal 2 has been classified under the domain of consequence as it relates to improving learner outcomes. Learners' improved attitudes could be observed in the their behaviour, enthusiasm to learn science, discipline in the classroom, and in the improvement of their overall performance.

Goals 5, 6, 10 and 11 from the Service Provider have been grouped under the external domain in Table 5.1. These four goals of ACE have been categorised because they were found to address what teachers would do in the external domain, such as in the community and other schools, or in a cluster of schools. The theories and information learnt in the ACE programme could benefit other teachers in the community or cluster, especially those who might not necessarily teach in the same school as the teacher who has completed the ACE programme. Furthermore, the teacher who has completed the ACE programme could use the skills gained to serve the community. Such a teacher could, for example, participate in decision-making committees within the community. Goal 10 refers to the teacher who has completed the ACE programme and is now a resource person in the neighbouring schools, or in the cluster. The achievement of this goal is observable in teachers assuming leadership roles to ensure that collaboration on issues related to the subject are dealt with. It has been found that not all of the categories as seen in Table 5.1 are fixed, as some of the categories could overlap when viewed from a different perspective, for example, goal 2 has been categorised under domain of consequence, while when goal 2 is viewed from a different perspective, it could be categorised under the domain of practice. This is plausible as the promotion of teaching can be observed in the domain of practice while learners' learning is part of the domain of consequence. In fact, the theoretical framework is based on the assumption that the change in one domain leads to development and growth in the other domains (Clarke & Hollingsworth, 2002).

The analysis of the Service Provider's goals for the ACE programme has revealed that the Service Provider regarded the improvement of classroom practice and the development of professional identity as important aspects of the ACE programme. This is evident from the eleven goals that were set out for the ACE programme by the Service Provider. The improvement of classroom practice and enhancement of professional identity by the Service Provider is necessary as to increase learner performance, one needs to enhance teacher knowledge (Guskey, 2002). Once teacher knowledge has been improved, learner performance could improve as well, however, it is acknowledged that there are other factors that affect learner performance. Factors, such as the learners' backgrounds, could also control and impact learner performance (Msila, 2014). In addition, Darling-Hammond and Sykes (2003) argue that it is a combination of factors like enthusiasm, academic ability, teachers' experience, as well as subject knowledge that influences learner performance.

5.4 ALIGNMENT BETWEEN THE DOCUMENTS OF THE SERVICE PROVIDER AND THE DOE

Firstly, the modules from the Service Provider's documents were compared to the seven roles of the educator, as reflected in the Norms and Standards for Educators. This comparison has been summarised in Table 5.2, and is discussed in Section 5.4.1. Secondly, the goals from the Service Provider's documents were compared to the seven roles of the educator, as reflected in the Norms and Standards for Educators (DoE, 2000). This comparison has been summarised in Table 5.3, and is discussed in Section 5.4.2. Thirdly, the ten modules were compared with the NS knowledge strands, as reflected in the RNCS NS Statement (DoE, 2002). The comparison between the NS modules, as designed by the Service Provider, and the NS Learning Area statement is discussed in Section 5.4.3.

Table 5.2: A comparison of the seven roles of educators and the ACE modules from the Service Provider

ACE modules versus Educators' roles	*Learning mediator*	*Interpreter and designer of learning programmes and materials*	*Leader, administrator and manager*	*Scholar, researcher and life-long learner*	*Community, citizenship and pastoral role*	*Assessor*	*Learning area /subject/ discipline/ phase specialist*
1.Life and Living	**x**	**x**					**x**
2.Matter and Materials	**x**	**x**					**x**
3.Planet Earth and Beyond	**x**	**x**					**x**
4.Energy and Change	**x**	**x**					**x**
5.Curriculum in Context		**x**	**x**	**x**	**x**		
6.Curriculum Development		**x**	**x**	**x**	**x**		
7.Approaches to Learning and Teaching	**x**			**x**		**x**	**x**
8.Classroom assessment	**x**			**x**		**x**	**x**
9. Learning and Teaching Science	**x**			**x**		**x**	**x**
10.Learning and Teaching Resources in Science	**x**			**x**		**x**	**x**

5.4.1 The seven roles of educators and the ten ACE modules offered by the Service Provider

As discussed in Section 1.4, teachers were enrolled for the ACE programme for upgrading and re-skilling purposes (DoE, 2000). According to the Norms and Standards for Educators, teachers are expected to demonstrate some competencies upon completing the ACE programme. These competencies were discussed in Section 5.2. The comparison of the seven roles of educators and the ten ACE modules offered by the Service Provider is shown in Table 5.2.

Firstly, it can be seen in Table 5.2 that the four content modules are aligned with three of the roles of educators, namely, being: a learning mediator, interpreter, and designer of learning programmes and materials, as well as a Learning Area specialist. Teachers who have completed the ACE NS programme and were found competent in these four content modules would be expected to mediate learning efficiently, and interpret and design scientific materials with ease as these content modules are aimed at preparing teachers to be specialists in this Learning Area.

Secondly, it was found that the two modules on curriculum, namely, ‘curriculum in context’ and ‘curriculum development’ were aligned to four of the roles of educators. These roles are to: be an interpreter and designer of learning programmes and materials; be a leader, administrator and manager; be part of the community; fulfil citizenship and pastoral roles, as well as being a scholar, researcher and life-long learner. In the researcher’s view, teachers’ ability to contextualise the curriculum will be observable in their interpretation of learning programmes. Such teachers should provide leadership in the Learning Area, and manage all the challenges related to teaching the curriculum. In the ‘curriculum development’ module, teachers are enabled to consider the context of the community in which the school is located when developing and selecting learning activities. In ‘curriculum development’, examples that are familiar to learners in a particular environment should be used. Examples suitable for learners who live in rural communities should differ from examples suitable for learners in an urban community. As lifelong learners, teachers should reflect on the curriculum and understand curriculum changes.

Thirdly, the last four modules, namely, ‘approaches to learning and teaching’; ‘classroom assessment’; ‘learning and teaching science’ and ‘learning and teaching resources’ were found to focus on teaching, learning and assessment. As indicated in Table 5.2, these four modules are aligned to four of the educator roles, which are: being a learning mediator, scholar, researcher and life-long learner, being an assessor, as well as being a Learning Area specialist. From the discussion above, it is clear that all of the educator roles are addressed by one or more modules.

It can be concluded from the ACE course package that the Service Provider planned to upgrade the teachers’ subject content, and teaching strategies and methods to enable them to assume all seven educator’s roles. The module on Learning and Teaching Science, for example, aimed to assist teachers to “explore and appl[y] various theories and strategies based on research to help improve the learning and teaching of science in an OBE classroom with a special focus on the educator roles of assessor, learning mediator and leader, administrator and manager” (Service Provider, 2013, p. 194). The four content modules were packaged to enhance the content knowledge of teachers in teaching NS in the Senior Phase. The programme was packaged so that:

> Application and extension of knowledge and skills acquired in Natural Sciences teaching subjects to areas of teaching and learning encompassed by the Learning Area, with particular reference to the Intermediate and Senior phases, including principles, concepts, outcomes, methodology and techniques; application of practical experience in natural science education, including aspects such as living organisms, materials, energy and Planet Earth; process skill enquiry and development; science in society; development of learning materials and resources; assessment and evaluation; classroom-based enquiry into specific Learning Area needs; application of knowledge and skills in diverse and unfamiliar educational contexts (Service Provider, 2013, p.169).

It can therefore be concluded that the ACE NS programme was structured to upgrade the teachers’ classroom practice, as well as enhance their professional identity. Similarly, the elements of classroom practice discussed in the above quotation refer to applying and extending the knowledge and skills acquired to areas of teaching and learning. This suggests that new knowledge and skills contribute to enhanced professional identity, which translates to new learning and teaching activities, which in turn enhances classroom practice. It could also suggest that teachers' approach to teaching should be activity-based so that learning is practical as far as possible. Teachers could be enabled to conduct practical activities in all content areas. The development of learning materials and resources; assessment, evaluation and classroom-based enquiry also addresses the classroom practice of teachers because the learning material and resources that are developed will be used in the classroom to enhance teaching and learning. Furthermore, the assessment, evaluation and classroom-based enquiry into specific learning areas refer to enhanced classroom practice. Teachers who have completed the ACE programme would be expected to apply the skills they were taught in the programme, for example, they are expected to apply the practical expertise gained to enhance the learners' process skills.

5.4.2 The seven roles of educators and the eleven goals of ACE offered by the Service Provider

Table 5.3 summarises a comparison of the seven roles of educators with the 11 goals of the ACE programme from the Service Provider's documents. The mapping that has been done in Table 5.3 indicates that each goal of the ACE programme from the Service Provider' documents is aligned with more than one role of educators. These roles are indicated in the Norms and Standards for Educators (DoE, 2000).

It is evident from Table 5.3 that the first goal of ACE, namely, to competently apply the knowledge, skills, values, principles, methods and procedures relevant to their subject, Learning Area or specialism, is aligned with five of the educators' roles, i.e. being a learning mediator; interpreter and designer of learning programmes and materials; being part of the community, fulfilling citizenship and a pastoral role; being an assessor, and a learning area/subject/discipline/phase specialist. The competent application of what the teachers have learnt in the ACE programme could be evident when they interpret and design learning programmes and materials. Teachers could apply the skills learnt to select activities from textbooks or from the internet that are appropriate for learners to learn. Moreover, the achievement of this goal would be evident in teachers becoming involved in community services, such as street committees. Teachers could also be part of community forums where decisions that will impact their communities in future are made.

The second goal, to continue to broaden and deepen their knowledge of content, skills, values and ways of thinking in their subject, Learning Area or specialism in ways that promote their teaching and their learners' learning, was associated with the four roles: being a learning mediator; scholar, researcher and lifelong learner, a subject specialist, as well as an assessor. During teaching, learning and assessment, the achievement of this goal could be evident in teachers' ability to teach beyond what the textbooks have explained. The achievement of this goal could manifest when teachers as scholars and life-long learners seek information on their subject. When teachers become scholars and life-long learners, they may strive to remain abreast of the latest information and new developments as a Learning Area specialist. This could be done formally or informally through the use of reference books or the internet.

The third goal, which is to continue to develop their pedagogical content knowledge and skills to provide a foundation for their teaching, relates to the five roles: being a learning mediator, interpreter and designer of learning programmes and materials, a scholar, researcher and life-long learner, part of the community, fulfilling citizenship and a pastoral role, as well as being an assessor. As teachers mediate learning, interpret and design learning programmes and materials, they will continually improve their pedagogical content knowledge. This could happen as they teach and assess the understanding of learners based on what they themselves were taught. If the assessment of learners reveals that they did not understand particular sections, then teachers could adapt their teaching strategies to accommodate the learning styles of learners. Learners who are struggling to understand scientific concepts could then be given special attention. However, learner performance is also influenced by factors within the learners themselves (Msila, 2014), and therefore requires teachers to assume a pastoral role.

The fourth goal, to understand principles underlying the curriculum and curriculum change and how knowledge is selected for the curriculum, is aligned with the three roles of being a leader, administrator and manager, interpreter and designer of learning programmes and materials, as well as a Learning Area specialist. The achievement of this goal could be observed when teachers' understanding of what the curriculum requires is reflected in a leadership role in the classroom whereby they manage resources and learning activities, as well as plan lessons.

As a Learning Area specialist, teachers could take up leadership roles in the cluster meetings of schools to assist other teachers. Teachers could lead the process of curriculum change as custodians of the curriculum, as they are in the best position to identify gaps and challenges that would have to be addressed should the curriculum be changed.

As seen in Table 5.3, the fifth goal, which requires teachers to link theory and practice and use theory as a tool to understand, think about and solve problems in their school/workplace and within broader educational and community contexts, has been associated with the three educator roles of being a scholar, researcher and lifelong learner; part of a community, and fulfilling citizenship and a pastoral role, as well as being an assessor. Teachers who are scholars, researchers and lifelong learners could apply theory that has been learnt to enhance their classroom practice, for example, teachers who have learnt about the theory of constructivism in the ACE programme would likely apply this theory when teaching science. Teachers who are life-long learners could be better positioned to solve problems related to learners and learning. They could better understand, for example, that different learners learn differently. Such knowledge could enable them to change their teaching strategies to accommodate all the learners in the classroom. In addition, when these teachers assess learners, they could implement new theories during assessment.

The sixth goal, to engage in classroom and school/workplace-based research, was found to be aligned with the two educator roles of being a scholar, researcher and lifelong learner, as well as being part of a community, and fulfilling citizenship and a pastoral role. Teachers could learn formally and informally. Formally, teachers could register with an institution of higher learning and pursue a qualification. Informally, teachers might learn from electronic media, educational magazines, seminars, conferences, workshops and from one another as colleagues. They could carry out research on the best methods to teach science. Furthermore, teachers could engage in action research to develop themselves professionally as science teachers (Hine & Lavery, 2014). Newly gained ideas from school- and classroom-based research may also lead to better support for learners, thereby fulfilling the pastoral role.

Again, the seventh goal, which concerns reflecting on cultural, social, political and economic issues in relation to subject content and barriers to learning, was found to be aligned with the two educator roles of being a scholar, researcher and lifelong learner, as well as part of a community, fulfilling citizenship and a pastoral role. Teachers who are scholars, researchers and life-long learners are be able to reflect on issues, as mentioned in this goal. When selecting learning activities, teachers could ensure that these learning activities reflect the culture of the community.

Again, the achievement of this goal could manifest when teachers select learning activities that accommodate the socio-economic status of the learners' parents. Teachers would be more sensitive in avoiding giving learners activities that would require their parents to spend a substantial amount of money, for example, projects that require parents to buy expensive materials. In addition, penalising learners who cannot bring improvised materials from home could be avoided by teachers who have achieved this goal. Reflecting on barriers to learning may also lead to supporting learners from a pastoral point of view.

The eighth goal, to communicate effectively in visual, written or alternative modes in the classroom, community and in their academic studies, as reflected in Table 5.3, was found to be aligned with five educator roles: being a learning mediator; interpreter and designer of learning programmes and materials, being a leader, administrator and manager, scholar, researcher and lifelong learner, as well as being part of a community, and fulfilling citizenship and a pastoral role. The achievement of this goal would mainly manifest in the domain of practice. During teaching, teachers could use the various teaching strategies to accommodate learners of different learning styles. Learners who struggle to understand when taught could be provided with special attention or 'pastoral' care. In mediating learning, teachers could use visuals like pictures and charts to explain some scientific concepts. Teachers who use such visuals could viewed as demonstrating the achievement of this goal.

The ninth goal, namely, to be able to extend their academic literacy in further study through understanding and using effective study methods, including accessing libraries and using a range of appropriate technology, was found to be aligned with two educator roles. These roles are: being a scholar, researcher and lifelong learner, as well as being a Learning Area specialist. Teachers demonstrating the achievement of this goal would be engaged in further study formally or informally. They could be engaged in reading and searching the internet for information that would enhance teaching and learning. They could also carry out research on best practices in teaching science and assisting learners to access information from a range of technologies and libraries.

The tenth goal, which was to understand career paths in education and take a leadership role in enabling and fostering collegial and co-operative ways of working among educators, was associated with two educator roles. These roles are: being a leader, administrator and manager, as well as being part of a community, and fulfilling citizenship and a pastoral role. Teachers could demonstrate the achievement of this goal in participating in the activities of their school clusters. They could participate by setting cluster assessment tasks and by facilitating and leading in the cluster's activities. They could also participate by supporting colleagues during the activities of the cluster. The teachers' understanding of career paths could be demonstrated by continuing their studies formally. This could include enrolling for a formal qualification after completing the ACE programme, which would encourage them to apply for promotional posts.

The eleventh goal, i.e. to take initiative in and responsibility for themselves, their work, communities and the broader natural and social environment, was found to be aligned with four educator roles, namely, being a learning mediator; leader, administrator and manager, being part of the community, fulfilling citizenship and a pastoral role, as well as being a scholar, researcher and lifelong learner. Teachers would voluntarily conduct extra classes in the morning or afternoon; sometimes during the school holidays; they would plan their lessons well in advance to allow sufficient time to prepare resources; conduct practical work despite resource challenges; they would accommodate learners who need special attention in class; and use the various teaching methods to accommodate the different learning styles of learners. These behaviours could also be observed in their involvement in the cluster of schools' activities.

Table 5.3: The seven roles of educators and the Service Provider's eleven goals of ACE

Educators' roles versus Service Provider's goal	*Learning mediator*	*Interpreter and designer of learning programs and materials*	*Leader, administrator and manager*	*Scholar, researcher and life-long learner*	*Community, citizenship and pastoral role*	*Assessor*	*Learning area /subject/ discipline/ phase specialist*
1. Competently applying knowledge, skills	**x**	**x**			**x**	**x**	**x**
2.Continue to deepen content knowledge	**x**			**x**		**x**	**x**
3.Continue to develop pedagogical content knowledge	**x**	**x**		**x**	**x**	**x**	
4.Understand principles underlying curriculum change		**x**	**x**				**x**
5.See links between theory and practice				**x**	**x**	**x**	
6.Engage in school-based research				**x**	**x**		
7.Reflect on issues in relation to subject				**x**	**x**		
8.Communicate effectively	**x**	**x**	**x**	**x**	**x**		
9. Extend academic literacies				**x**			**x**
10.Understanding career paths			**x**		**x**		
11.Take initiative	**x**		**x**	**x**	**x**		

5.4.3 Comparison of the ACE programme modules and the DoE NS Learning Area statement

Other than analysing the goals of the ACE programme from the Service Provider's document, the modules for the ACE programme as packaged by the Service Provider were also examined against the NS Senior Phase Learning Area statement. The Service Provider's document revealed that modules making up the ACE (GET) Science in this institution constituted: curriculum in context, curriculum development, energy and change; Matter and Materials; Life and Living; approaches to learning and teaching; classroom assessment; learning and teaching science, learning and teaching resources in science; and planet earth and beyond (Service Provider, 2013). It was found that the modules addressed the content knowledge and concepts of NS, as indicated in the NS Learning Area statement (DoE, 2002). Each module of the ACE NS programme was structured according to the knowledge strands corresponding to the policy document. The alignment of the modules and the DoE core knowledge and concepts is illustrated in Table 5.4.

In Chapter 2, it was discussed that subject knowledge, practical competence in conducting experiments, pedagogical skills, and language skills are elements of classroom practice. Modules like Life and Living, Energy and Change, Matter and Materials, and Planet Earth and Beyond are modules aimed at increasing science teachers' subject knowledge. These four modules are based on content and would allow teachers to learn more about the natural sciences content. Gaining content knowledge would further enhance the teacher's professional identity.

Apart from the four content modules, there are four modules related to pedagogy and two related to the curriculum. The course on classroom assessment and approaches to learning and teaching affects teachers' classroom practice because when teachers assess the learners, they would consider the way learners learn science, as well as the curriculum requirements. The curriculum requirements include the learning outcomes, as prescribed in the Revised National Curriculum Statement (RNCS) (DoE, 2002). When teachers understand how learners learn science, they are then expected to change their teaching practice to suit the learning styles and contexts of learners. The learning and teaching science course, for example, enables teachers to apply learning theories in their classroom.

The course on learning and teaching resources in science (Service Provider, 2013) also supports the teacher as an interpreter, designer of learning programmes and materials. It is in this regard that it is concluded that the course on learning and teaching resources in science addresses the classroom practice of teachers. Teachers who are not grounded in subject and pedagogical knowledge may struggle to interpret learning programmes and therefore these courses related to pedagogy and two related to the curriculum could assist the teachers with pedagogical knowledge.

Table 5.4 : Comparison of the RNCS core knowledge and concepts and the ACE programme modules

RNCS core knowledge and concepts versus ACE programme modules	*Life and Living*	*Energy and Change*	*Planet Earth and Beyond*	*Matter and Materials*	*Curriculum in context*	*Curriculum development*	*Approaches to learning and teaching*	*Classroom assessment*	*Learning and teaching science*	*Learning and teaching resources*
1.Life and Living	**x**									
2.Energy and Change		**x**								
3.Planet Earth and Beyond			**x**							
4.Matter and Materials				**x**						

*****It should be noted that though there is no indication in the form of a cross that the other modules are aligned to the core knowledge as stipulated in the RNCS document, they are somewhat aligned. For example, the Service Provider's module namely, curriculum in context is taken care by the statement " … science content from context which are significant to the learners and the local community may be used" (DoE, 2002, p.61).

5.4.4 Eleven Goals from the Service Provider's documents and the ten ACE modules

Table 5.4 depicts the mapping of the 11 goals of the ACE programme and modules, as indicated in the Service Provider's documents (Service Provider, 2013). It is shown in Table 5.4 that the first set of modules, namely, Life and Living, Energy and Change, Planet Earth and Beyond, as well as Matter and Materials, are content based and support goals 1, 2, 7, 8 and 9. Goal 1 is to competently apply the knowledge, skills, values, principles, methods and procedures relevant to their subject, learning area or specialism. Goal 2 is to continue to broaden and deepen their knowledge of content, skills, values and ways of thinking in their subject, learning area or specialism in ways that promote their teaching and their learners' learning. Goal 7 is to reflect on cultural, social, political and economic issues in relation to subject content and barriers to learning. Goal 8 is to communicate effectively in visual, written or alternative modes in the classroom, community and in their academic studies, and goal 9 is to be able to extend their academic literacy in further study through understanding and using effective study methods, including accessing libraries and using a range of appropriate technology. Teachers would be able to demonstrate what each of goals 1, 2, 7, 8 and 9 are intended to achieve after completing these content modules.

The second set of modules, namely, curriculum in context, curriculum development, classroom assessment, learning and teaching science, and learning and teaching resources supported goals 3, 4, 5 and 6. Goal 3 is to continue to develop their pedagogical content knowledge and skills to provide a foundation for their teaching. Goal 4 is to understand the principles underlying the curriculum and curriculum change, and how knowledge is selected for the curriculum. Goal 5 is to see links between theory and practice and use theory as a tool to understand, think about and solve problems in the school/workplace and within broader educational and community contexts, and goal 6 is to engage in classroom and school/workplace-based research.

Table 5.5: Mapping indicating how the Service Provider's modules support the eleven goals

Service Provider's modules versus goals	*Life and Living*	*Energy and Change*	*Planet Earth and Beyond*	*Matter and Materials*	*Curriculum in context*	*Curriculum development*	*Approaches to learning and teaching*	*Classroom assessment*	*Learning and teaching science*	*Learning and teaching resources*
1.Applying knowledge	**x**	**x**	**x**	**x**						
2.Continue to deepen content knowledge	**x**	**x**	**x**	**x**						
3.Continue to develop pedagogical content knowledge					**x**	**x**	**x**	**x**	**x**	**x**
4.Understand principles underlying curriculum change					**x**	**x**		**x**	**x**	**x**
5.See links between theory and practice					**x**	**x**	**x**	**x**	**x**	**x**
6.Engage in school-based research					**x**	**x**	**x**	**x**	**x**	**x**
7.Reflect on issues in relation to subject	**x**	**x**	**x**	**x**	**x**					
8.Communicate effectively	**x**	**x**	**x**	**x**						**x**
9. Extending academic literacies	**x**	**x**	**x**	**x**						
10.Understand career paths					**x**	**x**	**x**	**x**	**x**	**x**
11.Take initiative					**x**	**x**	**x**	**x**	**x**	**x**

Therefore, the teachers who have completed these modules would be expected to achieve and fulfil these goals. It should be noted that an exception was found in the course on approaches to learning and teaching, which did not support the goal of understanding the principles underlying curriculum change.

Lastly, the curriculum in context, curriculum development, classroom assessment, approaches to learning and teaching, learning and teaching science, and learning and teaching resources modules supported goals 10 and 11. Goal 10 is to understand career paths in education and take a leadership role in enabling and fostering collegial and co-operative ways of working among educators, and goal 11 is take initiative in and responsibility for themselves, their work, within their communities and the broader natural and social environment. The expectation is that the teachers who have completed these modules will demonstrate the achievement and fulfillment of these goals.

5.4.5 Conclusion

In this chapter, the outcomes envisaged by the DoE for the ACE programme and the goals of ACE from the Service Provider's documents were analysed and compared. The discussion was based on the seven roles of educators, followed by a discussion of the goals set out by the Service Provider. Finally, the alignment of the envisaged goals was examined. It can be concluded that the Service Provider's goals for the ACE programme were informed by the seven roles of educators, and that some goals of the ACE programme could be associated with more than one role of educators.

It has been established that the ten ACE NS modules offered by the Service Provider are aligned with the seven roles of educators, as indicated in the Norms and Standards for Educators (Service Provider, 2013; DoE, 2000). Similarly, the analysis of the documents from the Service Provider has revealed that the four content modules that the Service Provider had packaged for the ACE NS programme were drawn from the four content knowledge areas referred to as strands of NS in the RNCS (DoE, 2002). Overall, it can be concluded that the programme offered by the Service Provider was suitable in enabling teachers to fulfil the seven roles of educators, as envisaged by the DoE for the ACE programme. Chapter 6 will focus on an analysis of the data that was collected in the participating schools to gain an understanding of the classroom practice of the four participants.

CHAPTER 6 : FINDINGS: TEACHERS

6.1 INTRODUCTION

The analysis of the data collected from the DoE and Service Provider' documents were presented in Chapter 5. Chapter 6 presents the analysis of the data collected through the interviews, lesson observations and document analysis. The data collected through document analysis in this chapter is focused on the analysis of the learners' workbooks, as well as the teachers' documents and records.

6.2 ORGANIZATION OF THE CHAPTER

Each case is presented in this chapter following the sequence: introduction outlining the background of the case; interview; lesson observations and document analysis. Firstly, the interview in cach case are discussed using themes as headings secondly, lesson observations are discussed using the elements in the lesson observation schedule as headings and lastly, the criteria in the document analysis were used as headings. Then a summary for each case is discussed. The diagrammatical representation of findings is shown in Figure 6.1.

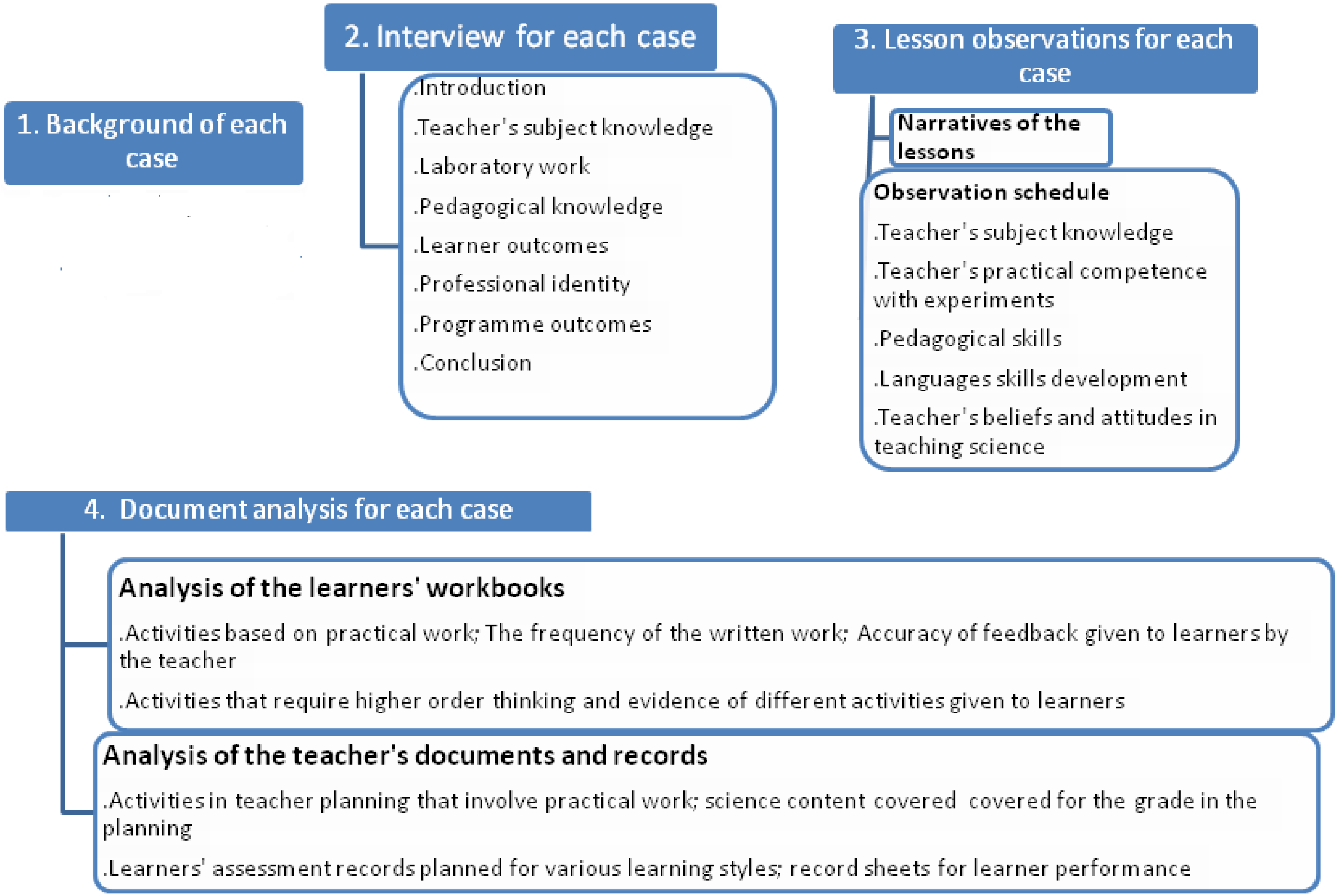


Figure 6.1: The diagrammatical representation of findings

6.3 MR WAKITHI'S CASE PRESENTATION OF DATA ACCORDING TO THEMES

Mr Wakithi had been a science teacher for 11 years. He was a post-level one teacher with matriculation, a Senior Primary Teachers' Diploma (SPTD), and ACE NS qualifications. Mr Wakithi's school was located on a farm and included grade R to 9. The learners remained in their classroom while the teachers moved to different classrooms for their lessons. There was no laboratory in the school, therefore the few science resources that the school had were stored in the cupboards of different classrooms.

6.3.1 Interview presentation of data according to themes

6.3.1.1 Introduction

The interview with Mr Wakithi occurred in his office, which he shared with other mathematics and science teachers in the school. He suggested that the interview be conducted during his free period, which was between 9h00 and 10h00. The office where the interview was conducted was calm and conducive for to the purpose of the interview.

6.3.1.2 Teacher's subject knowledge

Teacher's subject knowledge is a theme on its own, as seen in Table 4.6. Mr Wakithi believed that he had sufficient subject knowledge to teach the NS syllabus. He indicated that he had acquired subject knowledge from attending NS workshops. In his words he said "I attended workshops in NS for several times. Ngiyazama (I am trying) by all means to get new knowledge. I have sufficient knowledge for the subject". Although Mr Wakithi was of the opinion that the subject knowledge he had acquired was from the NS workshops he had previously attended, he later in the interview acknowledged that he had learnt from the ACE programme as well. This was noticed when he was asked about the science concepts that he had learnt from ACE, to which he responded, "Oh yes, then the science concept was 'life and living', ehe…(laughing) I will never forget this part of life and living whereby I was taught about the puberty age all in details I was taught more about the stars-some are gases some are liquids- there is one that is missing oh I will not get deeper". It was revealed in this response that Mr Wakithi learnt some content from the ACE programme that falls under the life and living strand of NS. He had also learnt content under the strand of planet Earth and beyond.

Furthermore, Mr Wakithi was asked to give an example of content he was struggling to teach. He did not mention the content, but instead cited teaching aids that he struggled to find when teaching about Matter and Materials. His response will be further discussed in Section 6.3.1.3 as this section deals with subject knowledge.

6.3.1.3 Laboratory work

The theme 'laboratory work', as indicated in Table 4.6, includes the categories of practical skills, resource needs, and improvisation. Mr Wakithi was asked if he had sufficient practical skills to carry out the prescribed experiments, he replied: "No, no, no the reason is I usually ask some teachers who have done some practical skills to kids after that. Some are more difficult they urge you as a teacher. As I say, I am not that good but I am trying. I think I don't have sufficient practical skills; I still need to improve and gain more practical skills. Hence, I say I am not that good but I am trying". His response indicated that he was aware of his inadequacy in practical skills. From this quotation it is concluded that Mr Wakithi consulted with other teachers who had conducted similar practical work previously to assist him where he lacked practical skills.

Mr Wakithi was asked how often he performed experiments with learners and said he conducted experiments at least three times a week. In his own words, he said "I do experiments at least thrice a week if ever maybe they are struggling and not more than four". His response seemed to be in contradiction with his earlier claim that he did not have sufficient practical skills to do experiments. Also, the notional time for NS in the Senior Phase, according to the policy, was 13%, which translated to about three hours per week (DoE, 2002). The accuracy of this response was improbable in view of the notional time available for NS and his challenges with practical skills.

In addition, Mr Wakithi was asked if he had enough apparatus to conduct these experiments. He said that he did not have enough apparatus and suggested that the lack of storage space could be the cause of the problem. The challenge of lacking apparatus was also mentioned earlier in the interview when he indicated that he struggled to teach content from the 'Matter and Materials' section because he could not obtain resources easily. As indicated in Section 6.3.1.2, Mr Wakithi was asked to give an example of the content he was struggling to teach but instead he mentioned teaching aids that he was unable to access when teaching 'Matter and Materials', he responded, "Matter and Materials yes, Matter and Materials because of ama teaching aids we are struggling to get teaching aids. Some of the things siyazenzela [we make for ourselves] on our own okunye [okunye meaning others]". Mr Wakithi also indicated that he did not have sufficient resources to teach the content from the planet Earth and beyond, and that he had to improvise when teaching content on volcanos, "Going out to the local tuck-shop and buy tartaric acid and vinegar." Earlier in the interview he made a similar remark, "Another content that I am struggling is volcano, that is, planet Earth and beyond. I have used some of the experiments linking them whereby I used tartaric and vinegar trying to explain more but just a matter of getting amamagazines." Mr Wakithi struggled to obtain some resources to conduct experiments but he then improvised.

6.3.1.4 Pedagogical knowledge

Understanding how learners learn science, and pedagogical skills categories were grouped under the theme pedagogical knowledge. All responses related to how Mr Wakithi planned lessons, and selected teaching and learning activities formed part of the pedagogical skill category. Mr Wakithi reflected an understanding of lesson planning to a certain extent in saying: "I usually plan lesson before going to the classroom. I plan for the whole in terms. In a term I can plan for the lesson that will cater for the whole term. If I have a spare time I plan for the whole term yes. I usually go to my old textbooks, my old textbooks". This response portrayed Mr Wakithi as an organised teacher who planned in advance. However, he did not clearly explain the process he followed to plan the lessons, except that he used his old textbooks when planning lessons. It was expected that Mr Wakithi would talk about consulting policy documents for the curriculum needs in terms of learning outcomes and assessment standards, addressing the prior knowledge of learners and confirming the content to be covered in the work schedule or in the policy document (DoE, 2002).

Furthermore, he was asked about what informed him of the learning activities to put in a lesson. Mr Wakithi did not respond directly to this question, but confidently stated "How do I decide? I decide I usually follow my schedule for the term; I do it on my own". He did not explain clearly how he chose the learning activities to include in the lesson, and only indicated that he used the work schedule for the term. Mr Wakithi did not give details about his choice of learning activities in his response. He did not indicate whether he considered the available resources, context of the school, background of the learners in terms of the community the learners came from, and their grade.

In addition, Mr Wakithi was asked regarding his understanding of the way learners learn science. He responded by saying “The system which is called expanded notation whereby you find the slow and fast learners. We usually take the fast learners to assist those that are slow.” It seems that Mr Wakithi was referring to ‘expanded opportunity’ as opposed to ‘expanded notation’ in this explanation. The researcher interpreted it that he understood that learners who are struggling to understand what you are teaching them might be slow and they need to be afforded more opportunities to complete tasks.

The second question, which sought to find out if Mr Wakithi understood how learners learn science was: How do you accommodate learners with different learning styles? Mr Wakithi responded by saying, “I usually divide them in groups and ask those who are struggling to come and work with the ones who are progressing well in class”. This response is in agreement with the previous response. It would seem that Mr Wakithi understood that learners learn best in groups because in his answers, the common element was learners assisting one another. However, it was expected that he would talk about using different forms of assessment with the learners, and the use of different teaching strategies. It was hoped that he might say that some learners were given texts to extract important information or they had to translate information from table to graphs, or that he carried out practical activities, or gave the learners pictures that depict what is taught.

The third question related to his understanding of how learners learn science through language skills. Mr Wakithi explained, “I try by all means to go in their standard and ask some teachers encourage them to use the dictionary, which is familiar to them, usually ask for some teachers who know the language of learners”. It was understood from this response that Mr Wakithi would do three things to assist learners to understand science when they had language difficulties. Firstly, he used simple language, which he referred to as “their standard” that he thought learners at their level would understand. Secondly, he would ask some of the teachers spoke these learners’ home language to assist. Thirdly, he would encourage the learners to use a dictionary.

The fourth question related to his understanding of how learners’ learn science through different kinds of experiences. Mr Wakithi did not give the kinds of experiences that he used in his response, but simply said “The love of nature”. It was then assumed that from his perspective, a love of nature was the kind of experience that would enable learners to learn science. It was expected that he would talk about experiences such as engaging in practical tasks, performing simulations, watching science demonstrations and perhaps visiting a science centre to view scientific exhibits. His response to the fifth question, which was related to how learners learn, was very similar to the previous response, "To make them aware that eh that without living organism which is around us we cannot go anywhere. The environment, whereby the ecosystem go in pollution, I try to convince them that they must love nature like brothers and sisters". The love of nature was mentioned again in this response. This indicated that Mr Wakithi believed that environmental awareness could support learning science.

6.3.1.5 Learner outcomes

The category of learner outcomes refers to performance, attitudes and behaviour. Mr Wakithi indicated that the learners had positive attitudes and enjoyed his classes. When asked if he thought that his classroom practice had changed, he said "Ma'am, it has changed because now kids are more eager to learn science each and every day. Everyday learners do not want me to go out from their classroom sessions". In another response where he was asked about whether learners enjoyed NS, he again referenced the eagerness of learners, "Eh Ha. I can say from attending ACE my learners have-has improved they are now eager to learn science." It is probable that Mr Wakithi measured his changed classroom practice by the learners' eagerness to learn science and passion to remain in his science class.

In terms of the learners' performance after completing the ACE programme, Mr Wakithi stated "They now love this NS more than any learning area because the results have improved dramatically since I completed ACE". However, despite the improvement in results mentioned, Mr Wakithi also indicated that some learners had not improved in writing their homework. He said "Ma'am, I do struggle a lot with them. Some are struggling to submit more work like in practical task in my natural science class. They differ, they are not same. There are the ones that submit the work on time. There are the ones that in writing task they struggling a lot, the NS facilitator once told us that in general sometimes we must not focus on spelling error. In general they differ submitting, some they write their homework in class, some they wait for you to give feedback and fill in work they were supposed to do at home". Clearly, the attitudes and performance of some of his learners had improved, while others were still performing poorly and displaying negative attitudes.

6.3.1.6 Professional Identity

The categories of teacher's beliefs, confidence, attitudes and collaboration were grouped under the theme of professional identity. Mr Wakithi displayed a lot of confidence when he was asked different questions during the interview. "The word confident is not enough. I am more confident". This quotation indicates Mr Wakithi's confidence in teaching science. It was also noticed that the category of teacher confidence appeared in several instances in Mr Wakithi's interview transcript. His confidence was observed, for example, when he was asked if he had sufficient subject knowledge to teach the syllabus in natural sciences. He responded positively to this question (Section 6.3.1.2). In another instance, he was asked if his subject knowledge had improved, he replied "Oh yes." Another instance where Mr Wakithi displayed confidence and positive professional identity was when he was asked about the choice of learning activities to use when planning a lesson, he said "I do it on my own".

At times his confidence was discredited by his own remarks about lesson planning, for example, when he was asked how he planned lessons, he confidently indicated that he planned his lessons in advance but later, when was asked how confident he was to share what was taught in ACE with other teachers in the cluster he then said "With the confident that I am having I even forget to do these lesson plan". Another example of his confidence was observed when he stated that "learners do not want me to go out from their classroom sessions". In another instance, he explained that the results of his learners had improved dramatically since he completed the ACE programme. His confidence was also observed when he responded that the lecturer had given them a chance to perform experiments in front of others, but after completing the ACE programme they were able to "correct" themselves. There were also other phrases from his responses that elicited teacher confidence, such as, "I am looking forward to be an NS examiner for the 4^{th} quarter", "I can see someone even utilise my skills", "You have to go deeper and seek more information". These responses reveal the depth of Mr Wakithi's confidence.

Responses that were viewed and coded as teacher's beliefs appeared several times in Mr Wakithi's interview transcripts. This could be an indication that Mr Wakithi believed in himself as a science teacher and this is reflected in his response when asked if he thought his classroom practice has changed, "Kids are more eager to learn science each and every day." Also, he reflected belief in himself as a teacher in explaining that his subject knowledge had improved, he said "Oh yes." Furthermore, Mr Wakithi believed that he was a better science teacher, "I wouldn't say better ...I can see someone even utilise my skills." Mr Wakithi displayed a belief that environmental education is valuable, for example, when asked about the kind of experiences that enable learners to learn science, he responded as indicated in Section 6.3.1.4 by referring to nature and the environment. These responses revealed Mr Wakithi's beliefs about the value of environmental education.

Mr Wakithi's attitude to teaching science was observed when responding to the different interview questions. During the coding of the data from the interview transcript, the code 'teacher's attitudes' was identified in several instances. Mr Wakithi displayed a personal awareness of environmental threats, and attempted to instil this attitude in his learners. He also displayed a positive attitude to towards teaching science in saying that he "Went an extra mile, I was going and going." Mr Wakithi's positive attitude was also observed when he was asked about his practical skills, saying "I am not that good but I am trying." His positive attitude was also observed when asked about lesson planning. He said, "If I have a spare time, I plan for the whole term, yes." Mr Wakithi also had a positive attitude about the ACE programme that he had completed. This was observed when he was asked if he enjoyed the ACE programme, he replied "Oh yes, I did enjoy the ACE." Furthermore, he was asked if he enjoyed teaching more than before he completed the ACE programme, which he indicated that he did. These responses indicated that Mr Wakithi had a positive attitude towards teaching science and about the ACE programme that he completed, and that he admired the lecturer, saying "the lecturer was so good." His response also revealed a positive attitude towards ensuring that teaching and learning occurred in the science class, as he had bought some of the resources required from the local tuck shop when the school could not provide these.

It was observed from the interview data that Mr Wakithi learnt the value of collaborating with other teachers for teaching and learning to be effective. This was observed when he responded that where he lacked practical skills, he asked other teachers. Also, when learners had difficulty understanding what they were taught and the language used when taught he explained, "[I] usually ask for some teachers who know the language of learners" and "I usually go to teachers that are familiar to that content". Mr Wakithi seemed to understand that he would not have all solutions as a science teacher, but that working together with other teachers might improve his classroom practice. Another instance where collaboration emerged was when he was asked to share any other information about his experience with the ACE programme, he stated, “You must share with other teachers.” As seen from his response, Mr Wakithi believed in collaboration, and when he was asked if he was willing to share what he learnt in ACE in a cluster meeting, he said: “Ma’am, I will be willing to share what I have learnt in ACE in cluster meeting because I am still sharing it. I am looking forward to be an NS examiner for the 4th term”. There were other phrases in Mr Wakithi’s responses that indicated that he believed in collaboration, for example, “You have to involve colleagues in class”, “You must share with other teachers” and “I will be willing to share” all of which indicate that Mr Wakithi was willing to collaborate with other teachers. Sharing in the cluster and a willingness to be an examiner was an indication that Mr Wakithi was eager to be a resource person in the cluster. All these responses indicate that, from his point of view, he had experienced growth in his professional identity as a science teacher.

6.3.1.7 Programme outcomes

All of the responses related to the envisaged and attained outcomes of the ACE programme were categorised under the theme of programme outcomes. Mr Wakithi was asked questions in an attempt to obtain his understanding of the envisaged outcomes of the ACE programme. He understood that it would improve his skills, teaching styles, to love science more and to learn more strategies. He also believed that the Service Provider wanted to “equip him with new strategies”. When asked how he thought his classroom practice was expected to change after completing the ACE programme, Mr Wakithi explained that he believed that “making his classroom friendlier” was another expected outcome of the ACE programme.

Mr Wakithi was also asked if he thought his classroom practice had changed, he responded, “Ma’am, it has changed because now kids are more eager to learn science each and every day. Everyday learners do not want me to go out from their classroom sessions”. He was convinced that his classroom practice had changed and he measured his changed classroom practice against the enthusiasm displayed by his learners. It seemed that his learners were more interested in the science class as compared to before he had completed the ACE programme. Moreover, he mentioned that the learners’ results had improved since he completed the ACE programme. It was indicated earlier that, according to Mr Wakithi, the learners’ behaviour had changed after completing the ACE programme as an outcome of the ACE programme. However, he indicated that some learners did not seem to have shown improved performance and continued to display negative attitudes.

When asked if he believed in himself and viewed himself as a better science teacher, Mr Wakithi indicated that he had appropriate content knowledge before, but that he learnt skills that he would share with others, “I wouldn’t say better (laughing), I know the basic content. I know how to go around it. I can see someone even utilize my skills which I have learnt from ACE. The thing of hypothesizing, all in all I can give my service”. Mr Wakithi also indicated that he enjoyed the programme and that he enjoyed learning new skills, “Ah…I enjoyed the ACE programme and the reason being that I have been taught to use apparatus which I never used before. The lecturer was so good that she gave us the chance to perform experiments in front of other colleagues. We were corrected whenever we made mistakes, after this programme we were able to correct ourselves”. It can be deduced that Mr Wakithi enjoyed the use of apparatus and the content in the life and living course, as taught in the ACE programme, “I was taught about the puberty age.” With regard to experiments, it is assumed that his professional identity was moulded during the ACE programme because the lecturer afforded an opportunity to perform experiments in front of other students.

Presumably such activities enhanced Mr Wakithi’s confidence and belief as a science teacher. When Mr Wakithi was given an opportunity to share anything about the ACE programme during the interview, he said, “I say as I went to the ACE programme what I have learnt as a teacher not of NS but a teacher in general… you must go and ask for more, you must share with other teachers. As I told you about the planets issue some of us are still think there are 9 planets while one is gone. You have to go deeper and seek more information. You must network as a science teacher”. This response further emphasises that Mr Wakithi’s professional identity was enhanced upon the completion of the ACE programme. He furthermore believed that he had learnt from the ACE programme that, as a teacher in general, he had to keep on learning and sharing with other teachers. All in all, it appeared as if Mr Wakithi had learnt from the ACE programme to be a lifelong learner, as seen in his statement. Moreover, Mr Wakithi was asked what he was taught in ACE that he currently practiced, to which he replied, “We were taught about togetherness you have to involve colleagues in class. I have to mention best practice we were taught about working togetherness where we have to involve colleagues in class we have taught about collaboration among ourselves taught to learn from learners. You have to learn from them. The practice I learnt from ACE was this collaboration among ourselves”. Mr Wakithi gave the impression that he had learnt collaboration from the ACE programme.

6.3.1.8 Summary of Mr Wakithi's interview

Mr Wakithi was relaxed throughout the interview session. He was comfortable in combining isiZulu and English in most of his responses. He responded to all the interview questions posed to him, however, he did not interpret all of the questions well. Mr Wakithi gave vague answers to some of the questions and, in such instances, those answers were found to be relevant to other interview questions in the study.

When Mr Wakithi was interviewed, he demonstrated an understanding that his classroom practice had changed after completing the ACE programme. He pointed out that he also learnt from workshops and did not ascribe his subject knowledge only to the ACE programme. He thought he did not have sufficient practical skills and equipment to conduct the prescribed experiments, but indicated that he was trying to teach content regardless of this challenge. In his responses it was concluded that he conducted experiments with the learners. In addition, with regard to pedagogical knowledge, Mr Wakithi said he assisted learners who struggled to understand language when taught, and indicated that he used different teaching strategies, such as grouping learners. Learners of different learning styles and those struggling to understand when taught would be accommodated by his classroom practice.

Mr Wakithi's beliefs about the expected changes were reflected in his responses to the interview questions. He indicated that learners' behaviour and performance had improved after he had completed the ACE programme. As discussed in Section 6.3.1.7, he measured the change in learner's outcomes by the enthusiasm displayed by learners, their behaviour change, and improvement in their results and submission of tasks. He explained that some learners had started submitting their work on time. According to Mr Wakithi, his professional identity improved after completing the ACE programme. These claims could not be verified as the study did not focus on, or collect data before he had completed the ACE programme. He was also confident in collaborating with other teachers to share and to learn from them. He indicated that he had collaborated with teachers on language and other issues when he required assistance with practical skills.

Mr Wakithi explained his views on the changes in his classroom practice in his responses to the interview questions. His explanation reflected what he was taught in the ACE programme. As indicated, he explained that he was taught "togetherness" in the ACE programme, and had learnt collaboration from the ACE programme. He also stated that his learners' results had improved since he completed the ACE programme. He even mentioned that his learners had become eager to learn science. To a certain extent, Mr Wakithi was able to explain the changes in his classroom practice. However, there were some inconsistencies in his responses which seem to indicate inaccurate information, in particular, he said that he conducted experiments three times a week, while previously he had admitted that he did not have sufficient apparatus because of storage problems and a lack of practical skills. Another inconsistency discerned in Mr Wakithi's responses was his response that he planned lessons in advance, yet he later responded that he sometimes forgot to develop lesson plans. These inconsistencies threaten the trustworthiness of parts of the interview data, but for the most part, his statements were consistent and regarded as trustworthy.

6.3.2 Lesson observations

Mr Wakithi presented six lessons for observation. Some of the lessons were presented before break and others were presented after break. Coincidentally, there was an equal number of lessons presented before and after break. One of the three morning lessons commenced at 8h00, in which three learners arrived 20 minutes late.

Table 6.1 Summary of the findings of Mr Wakithi's lessons

Lesson no.	**Topic**	**Duration of the lesson**	**Findings**	
			Learners' actions	**Teacher's actions**
1	Acids and bases	1 hour	✓ Read notes from the handout simultaneously ✓ Conducted tests on different substances ✓ Completed a worksheet that was attached to the notes.	✓ Gave learners a pamphlet with notes on acidic and alkaline solutions ✓ Explained the notes as learners were reading ✓ Supervised learners as they were completing the worksheet
2	Testing household substances for acidity or alkalinity	1 hour	✓ Brought household substances from home ✓ Copied in their workbooks a worksheet written on the chalkboard ✓ Tested the household substances for acidity or alkalinity by feeling and later using universal indicator	✓ Demonstrated to learners how to test substances for acidity or alkalinity using universal indicator ✓ Explained how the worksheet was to be completed ✓ Moved from group to group supervising learners ✓ Instructed the learners to complete the task at home
3	Classification of household	1 hour	✓ Tested substances then classified as acid or base or	✓ Explained to learners how the classification

Lesson no.	Topic	Duration of the lesson	Findings	
			Learners' actions	**Teacher's actions**
	substances		neutral ✓ Completed worksheets as they classify	was to carried out ✓ Supervised learners as they were testing and classifying substances
4	Formation of acid rain	1 hour	✓ Answered questions posed by their teacher ✓ Wrote the task given by the teacher in their workbooks	✓ Explained to learners acid rain formation ✓ Wrote chalkboard summary on acid rain ✓ Wrote on the board a task for learners to write
5	No actual teaching-the focus was on district assessment	1 hour	✓ Wrote feedback of the previous assessment on their workbooks ✓ Wrote answers of the district assessment in their workbooks	✓ Gave learners feedback on the previous assessment ✓ Explained each question of the new district assessment
6	Energy	1 hour	✓ Responded to questions posed by the teacher orally ✓ Copied from the board the homework given	✓ Introduced the lesson through oral questioning ✓ Gave learners homework and he wrote it on the board for learners to copy

6.3.2.1 Narratives of the lessons observed

Mr Wakithi's lesson presentations as observed are described in this section. The six lessons presented were sequential. The first lesson presented by Mr Wakithi concerned acids and bases. In this lesson, he gave learners a handout with notes where they were required to read from the notes simultaneously. The notes discussed acidic solutions and alkaline solutions. A worksheet formed part of the notes provided. As the learners were reading, Mr Wakithi stopped them whenever he wanted to explain further. He intervened and asked learners questions to check their understanding of what they were reading, for example, Mr Wakithi stopped the reading and asked the learners to predict if water could change the colour of litmus paper. He also wanted to know if water is acidic or alkaline. Again, he paused the reading and asked learners to predict whether ammonia dissolved in water could be an acidic or alkaline solution. Thereafter, the learners performed hands-on activities in groups in this lesson. They were required to test for the acidity or alkalinity of different substances that the teacher had brought to the classroom. He brought sunlight liquid, sodium carbonate, hydrochloric acid, magnesium sulphate and water. The resources were prepared in advance and were put on the table in front of the classroom for each group to access. After the activity was completed, Mr Wakithi summarised the lesson indicating that some substances, when dissolved in water, became acidic solutions and some became alkaline solutions. Learners also had to complete the worksheet attached in the notes. This lesson was concluded by giving learners a task where they were required to bring substances from home to be tested for acidity, alkalinity and neutrality. They were required to bring these substances in the next science lesson.

The second lesson that Mr Wakithi presented concerned testing household substances for acidity or alkalinity. As indicated earlier, learners were requested in the previous lesson to bring different household substances from home. The teacher introduced the lesson by revising the previous lesson. Thereafter, he requested learners use their hands to feel the different substances they had brought from home. They brought Sunlight Liquid (dish washing liquid), toothpaste, body lotion, vinegar, and Handy Andy (a cleaning detergent). When they were requested to feel the sunlight liquid, the learners indicated to Mr Wakithi that it was slippery. He then conducted a demonstration where he added a small amount of vinegar into a test tube, then a drop of universal indicator. He requested the learners to observe any change in colour. The learners were requested to continue testing the rest of the household substances brought from their homes. Mr Wakithi explained that they needed to observe colour change in each instance then decide whether it was acidic, basic or neutral.

The testing proceeded and Mr Wakithi moved from group to group supervising. In cases where learners did not indicate the colour, as expected by Mr Wakithi, he corrected them instantly. It seemed that Mr Wakithi had trialled the experiment before, and therefore was aware of the possible colour changes he expected learners to observe. The unexpected colour changes were taken as incorrect responses and learners had to repeat the testing in such instances. Mr Wakithi blamed a contamination of solutions for the unexpected colour observed by learners. The second part of this lesson focused on learners' written tasks. The written task required learners to copy the worksheet the teacher had written on the board where a substance tested was said to be acidic or basic. There was also a question in the written task where learners were required to define indicators. He explained what the learners should do in the written task, after which he concluded the lesson by requesting learners to complete the task at home.

The third lesson conducted by Mr Wakithi concerned the classification of household substances in terms of their acidity. This lesson was similar to the second lesson. The household substances brought by the learners from home for the second lesson were used in this lesson again. Learners worked in groups and verified the acidity as well as alkalinity of household substances by testing before classifying them. Substances were poured into the test tubes, followed by a universal indicator. Each group tested then classified the substances as acids or bases or neutrals. The teacher wrote out the worksheet on the board for learners to copy and later complete in their workbooks. As the practical activity was in progress, the teacher supervised the groups by moving from one desk to another. The lesson was concluded by requesting learners to finalise the completion of the worksheet.

The fourth lesson dealt with the formation of acid rain. The lesson was introduced by revising with learners the three forms of water. Mr Wakithi explained to learners that water exists in three forms, namely, gas, liquid and solid. Learners were involved in the lesson through oral questions. As Mr Wakithi was teaching on acid rain formation, he wrote summary notes on the chalkboard for learners to copy at the end of the period. The process of the formation of acid rain was concluded and the lesson was wrapped up by giving learners a task to write in their workbooks. The written task was based on recalling information that was taught during the lesson, and comprised questions that were extracted from Mr Wakithi's reference textbook. These questions were written on the chalkboard for learners to copy in their workbooks, then answer.

In the fifth lesson, there was no actual teaching that occurred, the teacher rather focused on the district assessment that is traditionally conducted in the province. The first part of the district assessment was to give learners feedback on the previous district assessment conducted. The second part concerned writing the new assessment. Mr Wakithi provided feedback to the learners by slowly reading the questions of the previous assessment. He allowed learners to write the feedback in their workbooks. He expected them to give answers and in instances where learners were struggling, Mr Wakithi gave the learners the correct answers. In the second part of the district assessment, learners were required to write the new district assessment. The teacher explained each question to the learners and concluded the lesson by giving the learners the opportunity to write the assessment in their workbooks. The district assessment cover page is depicted in Figure 6.1. The cover page reflects the details of the test and the learning outcomes, as well as assessment standards. It should be noted again that in 2013, when data for this study was collected, the RNCS document was still being implemented in Grade 7 (DBE, 2011b).

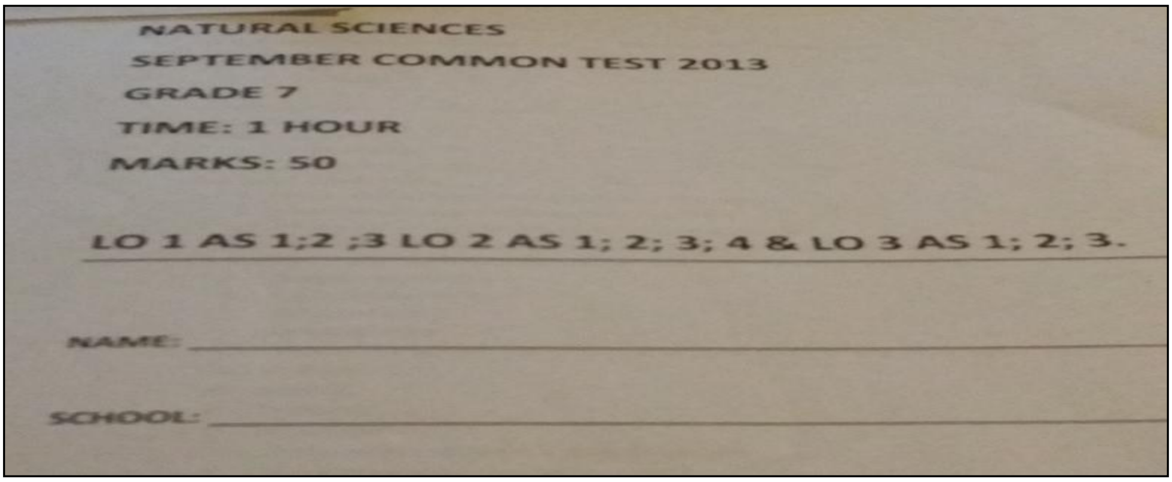


Figure 6.2: District assessment cover page.

The sixth lesson was on ‘energy’. The lesson was introduced, involving learners through oral questions. Learners were required to define energy as learnt previously. As the lesson progressed, Mr Wakithi wrote a summary on the chalkboard, which was copied by the learners into their workbooks. The lesson focused on how plants make their own food and how humans acquire energy. The learners actively participated in the lesson by answering oral questions. The lesson was concluded by giving learners homework to do. The homework consisted of simple recall kind of questions that Mr Wakithi wrote on the board without referring to any source. The learners were expected to respond to questions, such as: What is the main source of energy? How do plants make their own food? How do humans get energy? They copied the questions in their workbooks and were then expected to write the answers as homework.

6.3.2.2 Analysis according to the observation schedule

The data collected from the lesson observations was analysed in terms of the main elements captured by the observation schedule. These elements dealt with teacher's subject knowledge, practical competence in conducting experiments, their pedagogical skills, language skills, and lastly, beliefs about and attitudes towards teaching science.

Subject knowledge

In all of the lessons observed, Mr Wakithi explained the content correctly. In the first lesson where he gave the learners notes, they were required to read these notes. As the reading progressed, Mr Wakithi stopped the learners and explained the content further. In the second lesson there was not much to explain, except to revisit the definition of an indicator and this was linked to the third lesson, where they classified household substances.

In the fourth and sixth lessons, Mr Wakithi explained the content in the school's LoLT, as well as in isiZulu. His tendency to explain both in the LoLT and in isiZulu, as observed in the two lessons, was viewed as attempts to clarify the content further for learners to understand the work better.

He encouraged learners to ask more questions during most of the lessons presented. However, the learners were reluctant and did not use the opportunity. They did not ask any question in any of the lessons presented, except in the sixth lesson on energy where one learner wanted to know if non-living organisms need energy. Mr Wakithi responded appropriately, giving the learners an example of a car, which was a familiar example to the learners. They seemed to be content with the response the teacher provided.

Practical competence in conducting experiments

Mr Wakithi conducted investigations with the learners in three of the lessons. In each of these lessons, he selected the appropriate apparatus beforehand. In the first lesson, Mr Wakithi assembled the laboratory chemicals and the test tubes to be used in the experiment. All these resources were put on the front table for the group leaders to access. In the second and third lessons, learners brought household substances from home and prepared the test tubes and the indicators on the table, as it was done in the first lesson. Figure 6.2 depicts an example of how the apparatus were organised on the table for all groups of learners to access.

Figure 6.3: Apparatus and chemical prepared prior to the lesson

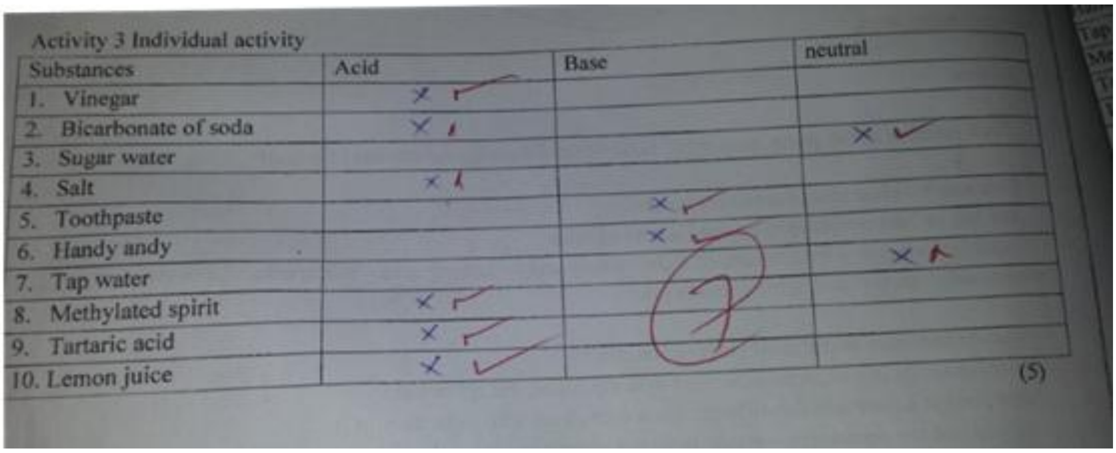
The investigations conducted were suitable for Senior Phase learners. These investigations were given in Chapter 5 of the RNCS document for the Senior Phase. As already indicated, in 2013 when the data for this study was collected, CAPS had not yet been implemented in the Senior Phase. Acids and bases were part of the core knowledge and concepts under 'Matter and Materials' in the NS RNCS document (DoE, 2002).

The purpose of the investigations was not clearly stated in the three lessons that they were conducted. It was observed that the purpose of the investigations emerged at the end of the activities, when Mr Wakithi concluded each of the lessons, for example, in the first lesson on acids and bases, it became clear when Mr Wakithi concluded the lesson that learners were testing different solutions to see which formed acidic and alkaline solutions. Similarly, in the second lesson on testing household substances, the purpose of the experiment emerged when Mr Wakithi explained to the learners how the worksheet was to be completed. The purpose of the experiment emerged as "testing different household substances to determine which were acidic or alkaline". Furthermore, at the end of the third lesson, it surfaced that the experiment assisted learners to verify and categorise substances into acids, bases and neutrals.

As already indicated, the apparatus were selected beforehand. It was observed that they were also checked for functionality. It seemed that Mr Wakithi had trialled the investigations before allowing learners to perform them because in the investigations conducted he was able to explain the unexpected colour changes in the different solutions. In the second lesson where learners tested household substances for acidity and alkalinity, one group had an unexpected colour change according to Mr Wakithi. Then, as indicated in Section 6.4.2.1, he immediately intervened and indicated that their solution was probably contaminated before being tested. His reaction indicated that he had trialled the experiment beforehand.

In the first lesson, learners were given a handout with notes. At the end of the notes there was a worksheet. In the second and the third lessons, the worksheet was written on the chalkboard for learners to copy into their workbooks, they were then expected to complete the worksheets. Each learner in Mr Wakithi's class had a textbook, but he sourced the worksheets from his reference textbooks. This was the reason why in one lesson, the worksheet was attached to the handout notes given to the learners, and in the two other lessons, where investigations were conducted, they were written on the chalkboard for learners to copy into their workbooks and complete.

Learners were guided on what to observe and write in the worksheets. In the first experiment, Mr Wakithi explained that they should write the responses as observed when they tested the different solutions. The answers had to be written next to the question asked in the worksheet. In the second lesson, learners were to write "acid", "base" or "neutral" next to the name of the household substance tested. In the third lesson, learners were required to categorise the household substances by putting a cross in the appropriate place on the worksheet. There were four columns, in the first column the name of a household substance was written, and the second, third and fourth columns were acidic, basic and neutral respectively. A copy of the worksheet for the third lesson is depicted below in Figure 6.4.


Activity 3 Individual activity

Substances	Acid	Base	neutral
1. Vinegar	X		
2. Bicarbonate of soda	X		
3. Sugar water			X
4. Salt	X		
5. Toothpaste		X	
6. Handy andy		X	
7. Tap water			X
8. Methylated spirit	X		
9. Tartaric acid	X		
10. Lemon juice	X		

(5)

Figure 6.4: Copy of the worksheet for the third lesson.

The worksheets were a means of assessing the learners' understanding of the investigations conducted. Oral questions were also used to assess learners' understanding of the investigations conducted. In the three lessons where investigations were conducted, the learners were expected to complete the worksheets, which were based on what they observed when conducting the tests. Learners were provided with opportunities to perform hands-on practical work in the three lessons. In the first lesson, they tested the given solutions using an indicator. In the second lesson, they tested household substances to determine which were acidic or basic. In the third lesson, they tested household substances to classify them as acids, bases or neutrals. Hands-on practical activities provided learners with opportunities to do, observe and better understand these scientific concepts.

Mr Wakithi conducted practical demonstrations. His approach in the practical lessons was to begin by showing learners how the experiment should be conducted, after which the learners were allowed to continue. In the first and the second lessons, he demonstrated to learners how to test the solutions for acidity and alkalinity using indicators. In the first lesson he showed them how to test using litmus paper, and in the second lesson how to use a universal indicator. Thereafter, the learners engaged in hands-on investigations where they tested other solutions and household substances.

Learners were able to see the demonstrations conducted because they were only 35 in a big classroom. Also, Mr Wakithi conducted the demonstration standing and lifted the test tube high up for all of the learners to see. In both lessons, demonstrations were part of the lessons and were not lessons on their own. Therefore, there was no separate assessment for the demonstration activity but on the whole of the practical lessons.

Pedagogical skills

Mr Wakithi demonstrated a range of pedagogical skills during the presentation of the lessons. The following skills were observed: continuous assessment, classroom management, constructivist approach, interaction with learners, learner participation, cooperative learning, and accommodating different learning styles. One pedagogical skill was not observed, namely, using discrepant events to explain further to learners.

Mr Wakithi understood that learners should be assessed continuously, which he did through oral questions. This was observed in all of the lessons presented. The completion of the worksheets was another form of continuous assessment used in the first three lessons observed. The two forms of assessments prevalent in Mr Wakithi's classroom were meant to continuously assess learners' understanding of what was taught.

It was observed that Mr Wakithi managed his classroom well. The learners, as observed, were well behaved. This was evident when learners followed his instructions as required and conducted some tests. Mr Wakithi's good classroom management skills were also observed during the lessons where investigations were conducted. He prepared apparatus well in advance and put them on the table in front of the classroom. Learners knew when to conduct investigations and present their findings. In the fourth and sixth lessons, where learners responded to questions, there was order in the classroom and he managed the oral questioning well; this was evident from the learners' good behaviour. Learners responded to questions only when allowed to do so. Therefore, Mr Wakithi managed the learning activities, resources and time in the classroom.

Mr Wakithi used constructivist principles, and this was observed when he linked the science content to the learners' previous knowledge and context. This was observed each time he asked learners questions during the lesson presentations. In the first lesson, for example, learners were asked to predict if ammonia dissolved in water could become acidic or alkaline. Learners knew ammonia from their context because multi-purpose cleaning detergents like Handy Andy contain ammonia and the learners were familiar with it. In addition, as indicated in the second and third lessons, learners tested household substances. When testing household substances for acidity and alkalinity, learners were requested to bring those substances from home. These were substances familiar to the learners because they were used at home. Also, in the fourth lesson Mr Wakithi introduced the lesson by revising the three forms of water as learnt previously before teaching about acid rain.

In the sixth lesson, learners were referred to their environment, specifically, the sun being the main source of energy for plants to make their own food. Mr Wakithi related the subject knowledge taught to real life examples, for example, in the first lesson, he used the example of turning fresh milk into sour milk by using tartaric acid. Furthermore, in the second and third lessons where learners tested and categorised household substances into acids and bases, they related the learning of this scientific content to real life examples of acidic and basic food at home. Furthermore, Mr Wakithi mentioned the real life example of the effects of acid rain in the fourth lesson. He explained the effects of acid rain on plants and animals in this lesson. Presumably, the learners could then explain the damages they saw in their environment in terms of what they had learnt in the science lesson. In the sixth lesson, the content was also related to real life examples when learners wanted to know if non-living organisms require energy. Mr Wakithi responded and gave the example of a car. He explained that a car needs fuel to travel from one point to the other. Consequently, it can be concluded that Mr Wakithi related the subject knowledge taught in science to real life examples. Mr Wakithi's pedagogical skills were also observed in the manner in which he interacted with the learners. He called learners by their first names and sometimes he called them "my brother" and "my sister". They were free to answer the oral questions asked. They conducted tests on chemicals and household substances in the first three lessons with confidence. Mr Wakithi supervised the learners when conducting investigations and interacted with them well by asking questions.

In the first three lessons, learners actively participated by engaging in hands-on investigations. They also completed the worksheets. Furthermore, they responded to the questions asked by the teacher in these lessons. In the fourth and sixth lessons, they were actively involved in answering the questions posed by the teacher. It can then be concluded that the learners actively participated in Mr Wakithi's lessons.

There was evidence of cooperative learning in some of the lessons Mr Wakithi presented. During the first and second lessons, learners were required to test solutions. Their ability to work together was evident when one learner held a test tube with a solution and the other learner added the indicator. The rest of the group members observed the colour change. In the third lesson, they argued and discussed whether to classify a particular substance as an acid or base. One learner suggested that the testing of solutions be repeated to end the argument, so cooperative learning was observed. In the fourth and the sixth lessons, there was no cooperative learning observed.

Mr Wakithi was not observed using models during the lesson presentations. However, in the first three lessons observed, visuals in the form of apparatus, laboratory chemicals and household substances were used. Mr Wakithi explained the content better with the use of these visuals. In the lessons where investigations were not conducted, there were no other visuals or teaching aids. Mr Wakithi accommodated the various learning styles of learners in one of his lesson presentations. This was evident in the first lesson where learners read the notes to benefit learners who learn better by reading. He demonstrated how to test solutions using an indicator, which benefitted learners who learn better visually. Furthermore, in this lesson, learners tested solutions themselves, which benefitted learners who learn best by doing. In all the other lessons, the accommodation of various learning styles of learners was not that prominent. Mr Wakithi did not use different teaching strategies in all the lessons. In the first three lessons, he used group work and allowed learners to work as individuals in completing the worksheets. In these lessons, oral questions were asked, which could be regarded as a teaching strategy that accommodated learners who learnt best by answering questions. In the remaining lessons, namely the fourth and the sixth lesson, direct teaching as well as oral questions were used. Direct teaching accommodated auditory learners who learnt best by listening.

In the lessons observed, it was only in the first lesson where it was evident that Mr Wakithi was aware of the learners' misconceptions related to colourless solutions that are viewed as water. He conducted a demonstration where he tested three colourless solutions using an indicator. One solution turned the litmus paper pinker, the second one blue and the last one did not change. He then concluded that not all colourless solutions are water. There were no other instances where Mr Wakithi's awareness of the learners' typical misconceptions was observed. Therefore, conducting practical tests seemed to be Mr Wakithi's strategy of addressing learners' misconceptions.

Mr Wakithi asked learners only low order questions during the first lesson presentation. The questions asked were "Is it an acid or base? What kind of solution do you get when ammonia dissolves in water? Does pure water change the colour of the litmus paper? In the second lesson, the questions asked were "Is it an acid or a base? What is an indicator? No questions were asked in the third lesson. In the fourth lesson, the questions asked were "what is acid rain? What are the causes of acid rain? Name four damages caused by acid rain. In the sixth lesson, the questions asked were "what do animals need to live? What is the main source of energy? What do plants need to grow? What do animals need to grow?

Mr Wakithi used direct teaching in the last two lessons presented. In the first two lessons, he used group work, then later allowed learners to complete the worksheets as individuals. When using direct teaching Mr Wakithi, asked learners oral questions, this assisted learners to be actively involved in the lesson by answering questions. The use of the discrepant events to further clarify concepts for learners was not observed in any of the lessons presented. All in all, Mr Wakithi demonstrated adequate pedagogical skills.

Language skills development

It appeared that Mr Wakithi did not plan learning activities to accommodate language skills in all of the lessons presented. The first lesson was planned to accommodate language skills development, as seen when learners read notes simultaneously from the board. It was assumed that this reading was supposed to enhance their reading skills. In the second and third lessons there were no activities to accommodate language skills. In the fourth lesson, reasoning as a language skill was exercised when learners were taught how acid rain affects animals and plants. Learners thought about the effects of acid rain on the environment. In the sixth lesson, there were no activities to accommodate language skills.

Mr Wakithi was concerned about learners who struggled to understand the LoLT. His concern was observed in all of the lessons presented as he code-switched to ensure that learners understood what he was teaching. In all of the lessons presented, Mr Wakithi code-switched appropriately when explaining. In the first lesson, he explained notes to learners in the LoLT, but he used some isiZulu comments in between for clarity. In all the other lessons presented, he was observed using isiZulu words as well.

Beliefs and attitudes

In all the lessons presented, Mr Wakithi displayed confidence in teaching science. He was observed moving from desk to desk supervising learners while they were engaged in hands-on investigations. In the fourth lesson on acid rain, he taught without referring to a textbook or preparation in front of him. He did not refer to any material as he taught. This indicated the confidence he had in himself as a science teacher. Presumably, this confidence was brought on by the specific subject knowledge he had of the subject (Section 6.3.1.6). As indicated earlier, he challenged learners to ask him questions so that he could explain even further. This was observed in the sixth lesson where he taught on energy.

Mr Wakithi was an enthusiastic teacher, as observed in all lessons he presented. He displayed enthusiasm when demonstrating to learners the testing of solutions for acidity and alkalinity. In the third lesson, he displayed enthusiasm as he moved from group to group supervising learners who were testing household substances. He was friendly and mobile in class throughout the presentation of the lessons. He displayed a positive attitude to teaching science and believed in himself as a science teacher.

He inspired the learners by asking them questions. He did this to keep the learners involved in the lessons. In the second lesson, he required learners to predict before testing the household substances. In the third lesson, he inspired learners as he moved from group to group asking the learners questions why a particular substance was categorised as a base and not an acid. In the fourth and fifth lessons, he asked them questions as a way of inspiring them to learn science.

6.3.3 Document analysis

A document analysis was conducted to collect the data required to answer the research question. The presentation and discussion of the document analysis is set out according to the elements of the document analysis guide. The analysis of the learners' workbooks is presented first, followed by Mr Wakithi's documents and records.

6.3.3.1 Learners' workbooks

Three learners' workbooks were chosen by the teacher for analysis. The analysis of the learners' workbooks was conducted using the document analysis Guide 1. This document analysis guide is attached at the end of this thesis as Appendix 3 and has some elements that guide the document analysis. These elements were: activities based on practical work, the frequency of written work, accuracy of feedback given to learners by the teacher, activities that require higher order thinking, and evidence of various types of assessment given to learners. These are discussed in this section.

Activities based on practical work

There was evidence of activities that were based on practical work in the learners' workbooks, although the majority of the written tasks were based on recalling information. In these activities, learners were required to respond to questions that were based on the experiment and practical task conducted. Four such tasks from January to August were entered in the learners' workbooks. Three of the four were conducted during lesson observation periods. It was noted with interest that the learners' workbooks reflected most of the activities based on practical work during the lesson observation. The tasks based on investigations were to investigate acids and bases at home, and whether tea can be used to test the acidity, testing and categorising household substances. There was written work in the learners' workbooks, some based on practical and some not. The majority of the written activities in the learners' workbooks were not based on practical work. Therefore, the practical work conducted during lesson observation period were viewed as an indication of the Hawthorne effect as explained by Leonard & Masatu (2006).

The frequency of written work

It was found from the analysis of the learners' workbooks that there were 38 written tasks by the end of August. In January, there were four written tasks, two in February, two in March, eight in April, seven in May, one in June, six in July, and eight in August. More written work was expected in February than in January in the learners' workbooks because in January there were two weeks of school, compared to the four weeks of school in February. The trend observed in the learners' workbooks was that learners were given written work at the completion of a particular topic. The learners' workbooks reflected 38 written tasks, of which only 4 were based on practical work conducted.

Accuracy of feedback or corrections given to the learners by the teacher

Mr Wakithi gave learners feedback on the written work because there was evidence of corrections found in the learners' workbooks. It was reflected in the learners' workbooks as they wrote corrections using pencils, as seen in Figure 6.5, and in some instances they wrote corrections separately, as seen in Figure 6.6. The feedback on the assessment tasks given by Mr Wakithi was found to be correct and it was obvious that he controlled the learners' workbooks as his signature was present.

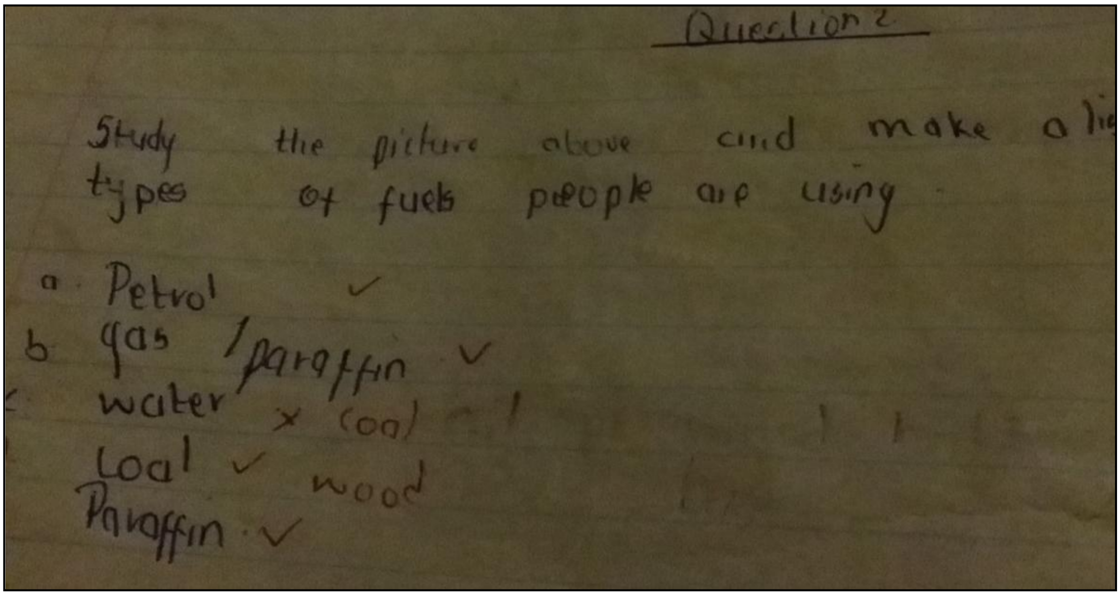


Figure 6.5: Feedback in the learners' workbooks written in pencil.

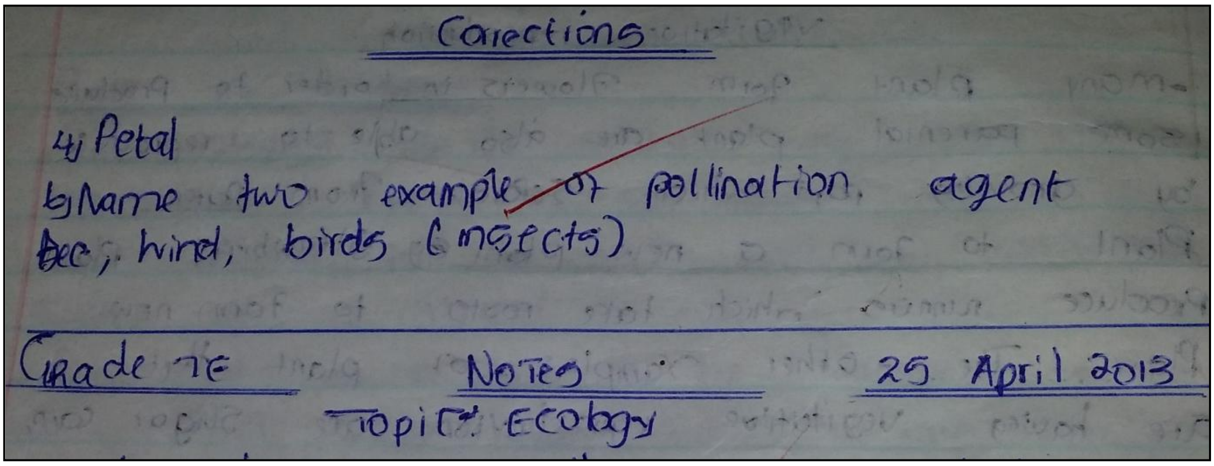


Figure 6.6: A different way of learners writing the feedback

Activities that required higher order thinking

Most of the activities given to learners were found to require lower order thinking as they mainly required learners to recall from memory. A few questions such as, “explain the differences between asteroids and comets”, “investigate acids and bases from home”, “describe the causes of an earthquake” and “look at the picture then answer questions", “discuss why the Sun is regarded as life giving in our Solar system” were found in the learners’ workbooks. These were a few of the questions requiring higher order skills involving at least analytical thinking from the learners. Therefore, to an extent, Mr Wakithi gave learners activities that required higher order thinking.

Evidence of different types of assessment activities given to learners

Learners’ workbooks depicted different types of assessment activities and this indicated that different learning styles were accommodated in Mr Wakithi’s classroom. The different types of assessment activities ranged from completing the worksheets, translating tasks, case studies, investigations, and class tests. All these different types of assessments activities were found in the learners’ books. These were formal assessment tasks, so Mr Wakithi marked these himself. There were two types of assessment activities found in the learners’ workbooks, Figure 6.7 depicts the learners’ homework and a class test.

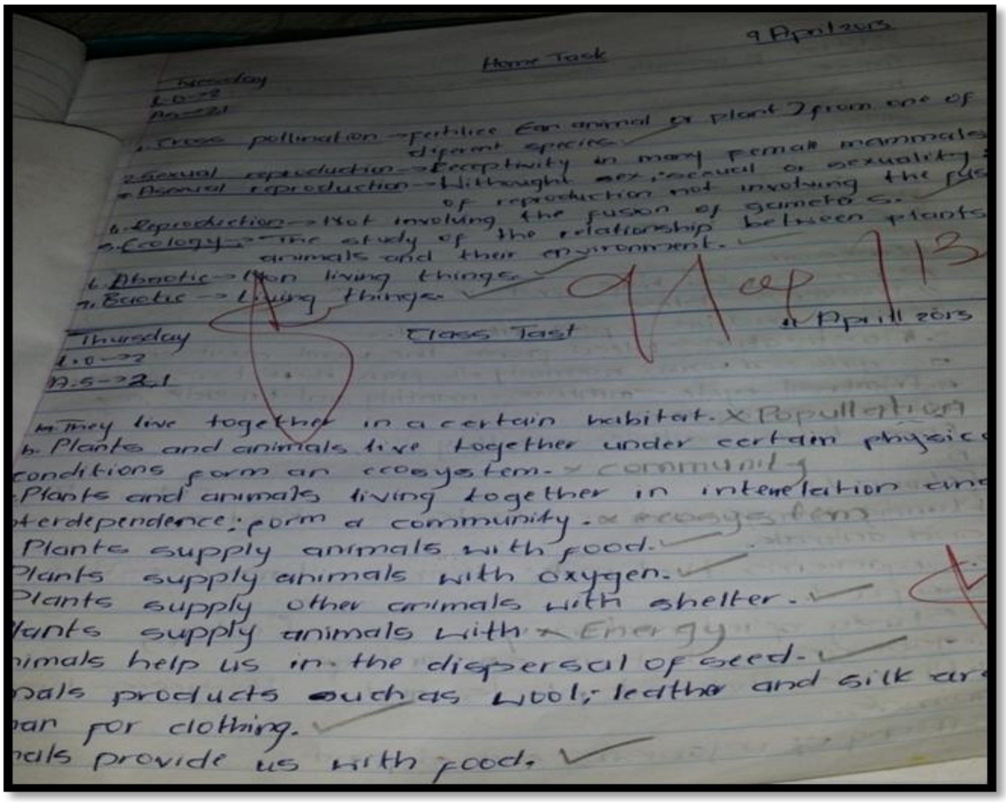


Figure 6.7: Example of assessment activities reflected in the learners' workbooks.

6.3.3.2 Analysis of the teacher's documents and records

The documents analysed included the work schedule, lesson preparations and programme of assessment. Mr Wakithi's file was requested during each visit after the lesson observations. He had one file containing all of these documents. The analysis of Mr Wakithi's documents and records was conducted focusing on activities in his planning that involved practical tasks, scientific content covered for the grade in the planning, learners' assessment records planned for the various learning styles, and recording sheets for learner performance.

Activities in teacher planning that involve practical work

There were copies of worksheets and handouts in Mr Wakithi's file indicating activities that involved practical work. Worksheets on determining the usefulness of tea in investigating acids and bases; separating mixtures; classifying substances as acids and bases; as well as a worksheet with a picture of fractional distillation where learners were to respond to questions asked were present. Handouts with activities on explaining how water and sand can be separated; and what methods of separating mixtures are called were also found in Mr Wakithi's file.

Scientific content covered for the grade in the planning

The lessons prepared found in Mr Wakithi's file reflected scientific content covered for the Grade 7 class. Lesson preparations were done and kept in his file. Mr Wakithi used the departmental work schedule for planning the lessons, and the content in the lesson planning was in agreement with the work schedule for Grade 7. The scientific content covered included all the core knowledge and concepts of natural sciences, these were life and living, planet Earth and beyond, energy and change, as well as Matter and Material. The departmental work schedule was developed such that the life and living content areas were covered in the first term; Planet Earth and Beyond in the second term; Matter and Materials in the third term, and Energy and Change was allocated to the fourth term. Mr Wakithi's planning reflected the scientific content covered for the grade.

Learners' assessment records planned for various learning styles

Mr Wakithi had a programme of assessment in the file where the assessment planned for the learners and dates were indicated. The programme of assessment indicated translation tasks, investigations, case studies and class tests. These were indicated as formal assessments to be recorded. There were also planned informal assessments in the form of homework and class work handouts in Mr Wakithi's file. It appeared that the different assessments in the file were meant to accommodate learners with various learning styles.

Recording sheets for learner performance

The recording sheets found in Mr Wakithi's file were typed indicating the names and marks of learners, which were converted to percentages. Learners' percentages ranged from 22% to 80%. It was reflected in the recording sheets that Mr Wakithi assessed the learners formally according to the policy on assessment (DoE, 2004). There were two formally recorded assessment tasks indicated per term. The informal assessments were not reflected in the recording sheets.

6.3.4 Summary of Mr Wakithi's case

Three data collection methods were used in the current study, namely, interviews, lesson observations and a document analysis. As indicated in Section 6.1, the interview was conducted first, while lesson observations, as well as document analysis were conducted next.

The lesson observations revealed that Mr Wakithi had sufficient knowledge to teach science in Grade 7. He explained during the interview that he gained content knowledge from workshops prior to the ACE programme, but that he had also learnt more knowledge during the ACE programme. In addition, he related the content taught to real life examples. Furthermore, the analysis of his documents and records revealed that he planned to teach all the content as reflected in the work schedule provided by the department. This was confirmed in the analysis of his documents and records, where it was found that his lesson preparations reflected the content as outlined in the departmental work schedule. This result is in alignment with the theoretical framework for the study (Clarke and Hollingsworth, 2002), Mr Wakithi's knowledge to teach science as he mentioned in the interview was acquired from the external domain and from his "self-reports". The external domain in his case was NS workshops and the ACE programme.

He indicated during the interviews that he still lacked practical competence in conducting experimentss. However, the lesson observations revealed that he actually had good practical skills. Learners' workbooks were found to contain activities that were based on investigations; however, they were only a few. Mr Wakithi claimed during the interview that he did not have sufficient apparatus and therefore he sometimes improvised. During the lesson observations, this improvisation was observed. The data collected through the interview and the lesson observations on improvised material corresponded. This positive result on improvisation confirmed that his professional identity was enhanced and according to the theoretical framework of the current study improved professional identity enhances the classroom practice. This is illustrated by arrow 2 in figure 3.3 (Clarke and Hollingsworth, 2002).

Mr Wakithi explained during the interviews that he planned his lessons using the work schedule provided by the department. He also said that he sometimes planned for the whole term. Indeed, this was confirmed by the data collected through the document analysis, as indicated earlier, that the planned lessons reflected the content in the work schedule. During the lesson observations, it was also observed that there were planned worksheets and questions for learners to respond to. Some of these worksheets were found pasted with glue in the learners' workbooks. The analysis of Mr Wakithi's file also reflected planned lessons and assessment tasks for learners. Therefore, there was agreement among these data collection methods with regard to planning. Being able to plan lessons, assessment tasks and worksheets is related to the salient outcomes resulting from teacher's professional identity and classroom practice in accordance with the theoretical framework. This is illustrated by arrow 5 and 6 of Figure 3.3. It was discussed in Section 3.4 that the personal domain and the domain of practice influence the salient outcomes located in the domain of consequence (Clarke and Hollingsworth, 2002).

Mr Wakithi indicated during the interview that he accommodated learners who struggled to understand what he taught by using the strategy of group work. This was observed when he taught, as group work was one of the teaching strategies used. Learners conducted investigations in groups in the lessons where investigations were conducted. The document analysis indicated that in some of his lesson planning learners, were to perform investigations in groups. He indicated during the interview that learners who struggled with the LoLT made use of a dictionary, and he collaborated with other teachers to assist in these cases. This claim could not be confirmed during the lesson observations. Mr Wakithi code-switched to explain to learners who struggled with language. He indicated during the interviews that although the learner outcomes had improved, he still struggled with a few of the learners. Indeed it was observed that in one of the lessons, some learners arrived late for a lesson.

As discussed in Section 6.3.1.4, Mr Wakithi said he planned his lessons, although he did not mention the policy document as one of the planning documents used. Moreover, the document analysis revealed that Mr Wakithi prepared lessons that were appropriate for Grade 7 NS. It was observed during the lesson presentation that he had good pedagogical skills where he applied constructivist principles such as assessing learners continuously and teaching using real life examples.

Mr Wakithi demonstrated good professional identity during the interviews and lesson observations. He was confident when responding to questions asked. He said he believed in collaboration and was willing to be a resource person in the cluster. He also had a positive attitude towards the ACE programme that he had completed. This was noticed in the remarks he made about the ACE programme (Section 6.3.1.7). This suggests that arrow 9 of Figure 3.3 applied in Mr Wakithi's case as he was confident to be a resource person in the external domain (Clarke and Hollingsworth, 2002).

Consequently, there was agreement between the three data collection methods. It can be concluded that the alignment of the three instruments was not observed in all the elements of classroom practice, but in the majority of these elements.

The most remarkable opinion Mr Wakithi revealed about how ACE had changed his classroom practice was collaborating with other teachers, which he referred to as "togetherness", and learning to use apparatus he had never used before. He also aspired to be an examiner in the cluster. The exploration of Mr Wakithi's views on classroom practice revealed that he thought he was a better science teacher in terms of subject knowledge, practical competence, pedagogical skills, language skills and professional identity.

6.4 MR MASHANGURA'S CASE

Mr Mashangura's school was located in a township and included Grades R to 7. Learners rotated, while the teachers in this school remained in their classrooms. There was no laboratory in the school and the few apparatus they had were stored in the teacher's cupboard. Mr Mashangura had 22 years of teaching experience in science. He was a post level one teacher with matriculation, an FDE, and an ACE qualification in natural sciences.

6.4.1 Interview– presentation of data according to themes

6.4.1.1 Introduction

The interview with Mr Mashangura was conducted in a small staff room shared with other teachers whose classrooms were located in the same block. Mr Mashangura requested that the interview be conducted at 14h00, for the duration of one hour. The environment was quiet and conducive to conducting an interview.

6.4.1.2 Teacher's subject knowledge

Mr Mashangura was asked if he had sufficient subject knowledge to teach the syllabus in NS. He responded positively to the question by saying "yes", but did not elaborate, which seemed unusual. Another question related to the subject knowledge was asked where he was expected to mention the subject knowledge struggled to teach, his response was, "Eh! I can say is acids and base due to what? Lack of lab at the school." It sounded like Mr Mashangura was struggling to teach acids and bases because the school did not have a laboratory. It was not necessarily true that he lacked content knowledge related to acids and bases. His response will be discussed in detail in Section 6.4.1.3 as it relates to resource needs rather than teacher’s subject knowledge. Later in the interview, Mr Mashangura was asked if his subject knowledge had improved after completing the ACE programme and he responded positively by saying “Definitely!” Also, when asked to mention one scientific concept he thought he had learnt in ACE, Mr Mashangura did not specify any specific concept, but talked about laboratory work and his teaching style. Therefore, this response will be discussed in Sections 6.4.1.3 and 6.4.1.4, as it relates to laboratory work and pedagogical knowledge. It seems that Mr Mashangura did not have clarity about specific content that he struggled to teach or specific content that he had learnt during the programme.

6.4.1.3 Laboratory work

As shown in Table 4.6, laboratory work comprises practical skills, resource needs and improvisation categories. The coding for practical skills appeared several times in Mr Mashangura’s interview transcript. When asked if he had sufficient practical skills to conduct the prescribed experiments, he replied “yes” but did not elaborate. He was then asked how frequently he conducted experiments with learners and gave a vague response, “Eh I control… by the context according to the strands you understand it means I was supposed to do it once a week due to the stands [strands]”. He did not address the question adequately; it is still unclear how often he did laboratory work. However, this response indicates that although he was aware that he should conduct experiments once a week, it did not really happen that often.

He also mentioned the use of practical experiments to assist learners who struggled to understand what he was teaching. It seems Mr Mashangura relied on his practical skills to assist learners to understand what he was teaching because he also mentioned “practical experiments” when asked how he helped learners to understand science when they had language difficulties. Mr Mashangura mentioned “Teaching by doing experiments” at one point during the interview, and it seemed that he believed that doing experiments was part of teaching science. Furthermore, “Investigation and doing experiments...” was one activity he said he enjoyed in teaching science, which suggests that he did not experience challenges with regard to practical skills.

Resource was seen as a challenge to Mr Mashangura in teaching science and conducting experiments, for example, he said he struggled to teach acids and bases because of the lack of a laboratory in the school. When asked if he had enough apparatus to do experiments he said:

"Eh! Apparatus partially, partially they are not enough. Before I answer that question partially due to there is no safe place the way I told you that we are lacking. Before you want to do experiments it is time consuming". Mr Mashangura emphasised that they did not have enough apparatus. It seems that they had insufficient apparatus and there was no laboratory in the school where the few resources that they had could be stored.

Mr Mashangura also indicated that the apparatus were put in the cupboards in different rooms in the school, and that collecting and assembling apparatus in class was time consuming. He repeated, "I said partially they are not enough. Because you will find that they are put in a cupboard they are not on one place, you suppose to come with them on time to put in class". It seems he was of the opinion that keeping resources in one place could save him preparation time in conducting experiments.

The next question Mr Mashangura was asked related to the occasional use of improvised materials to conduct experiments, to which he replied, "Yes...ha...example for doing something maybe I can tell children to come with apparatus from home which are familiar to them. Yes they have apparatus at home which are familiar. I can go round the school". From this response, it is not clear if he really used improvised apparatus, as he seemed to speculate about what could be done. He clearly understood that he could ask learners to bring the resources to be used from home, and that he could also use materials from the vicinity of the school.

6.4.1.4 Pedagogical knowledge

The theme of pedagogical knowledge comprises the categories of understanding learners, and pedagogical skills. Several questions related to lesson planning, the way learners learn science and how he provided for different learning styles were posed.

Firstly, Mr Mashangura was asked questions related to lesson planning. When asked how he planned lessons, he explained, "Eh ….It is developed from a year-long plan and the learning programmes by identifying the role…. And also it's developed by the individual teacher". He was expected to refer to the policy document for the verification of the alignment in terms of the learning outcomes and assessment standards. He was also expected to mention the different resources he used to plan lessons, but he simply referred to using the year plan that the district provided. Although he did not clarify what he meant by "identifying the role", it was concluded from his response that he did individual planning using the learning programme. Furthermore, Mr Mashangura indicated that he sometimes used the internet to prepare lessons. He also indicated that the institution where he completed the ACE programme gave them a form, which he later referred to as a lesson development frame. Mr Mashangura indicated that the frame had all the components that should be reflected in a lesson plan. In his own words he said, “It has all the activities needed in the lesson plan”.

Later, during the analysis of Mr Mashangura’s document, it was found that he was referring to a template for planning lessons. Furthermore, he was of the opinion that planning is important, saying “You cannot go to the class without planning you must be thoroughly prepared.” When asked to explain how he chose learning activities to use in a particular lesson, he gave a vague answer, “Ok …learning activities teaching approach is very important”. He did not respond to the question about the choice of learning activities to use in a particular lesson. It was expected that he would mention that he used the policy documents to check the curriculum needs, the context of the school, and the learners’ prior knowledge. However, his response reflected the importance of a teaching approach, which did not address the question.

Secondly, Mr Mashangura was asked questions about how he understood the way learners learn science. When asked what he did when learners struggled to understand what he taught them, he said, “I use the practical experiment and also maybe applying the, using the teaching aids like the teaching aids, like pictures”. This indicates that he understood that different learners learn differently. Those who struggle to understand what he taught might understand if they were engaged in practical activities like an experiment. Mr Mashangura knew that some learners learn best with visuals, and therefore he used teaching aids like pictures to promote understanding. Thirdly, he was also asked how he accommodated learners with different learning styles. Confidently, he said, “Eh learners with different learning styles…I provide pictures and repetition keys like ideas linking the concepts”. This has revealed his understanding of how learners learn science. Mr Mashangura displayed an understanding of constructivist learning again when he was asked how he helped learners when they had language difficulties. He responded by saying, “I help them through the resources, eh, I have like practical experiments, models, pictures and also their environment”. He understood that some learners who struggle with language would understand concepts better with the use of models, which is why he showed them pictures of what was being taught. Furthermore, his response indicated that he conducted practical experiments to clarify what learners may have been struggling to understand. This response seemed to be a contradiction to what he had said earlier about resources that were scarce in his school. It was expected that Mr Mashangura would mention code-switching as one way to assist learners who do not understand language.

Mr Mashangura was also asked about the kinds of experiences he thought would enable learners to learn science. He responded by saying, "Maybe by touching and feeling, you understand, maybe they are doing experiment and find that these learners are not coping…maybe I allocate work to them if they can't get my style well in group work so that learning occurs can allow allocate work to them". Once again, Mr Mashangura showed the understanding that using the senses, like touching and feeling, promotes learning. He also understood that learners learn best when exposed to practical activities, using teaching aids and pictures. Even when the school had no apparatus, he would request learners to "...come with apparatus from home..."A similar response was given when he was asked why he thought learners enjoyed science; he mentioned "That they play games, they touch things." He further believed that allowing learners to work in groups was another kind of experience that allowed them to learn science. Overall, Mr Mashangura believed that learner engagement could enhance learning as he persistently mentioned the use of practical experiments, touching, feeling and pictures in his response.

6.4.1.5 Learner outcomes

As indicated in Section 6.3.1.5, learner performance, attitudes and behaviour were grouped under the category learner outcomes. Mr Mashangura indicated that his learners' behaviour changed after he had completed the ACE programme, saying, "They want to concentrate…in order to challenge the question asked in class and since they know in science we talk about true things, real things. You cannot say a child come from the ambulance … cannot say the child come from the river or aeroplane or ambulance. They have to understand that in reproduction the egg will meet the sperm cell". This response indicated that his learners became more interested in science lessons. Furthermore, it appeared that the learners had become more motivated and inquisitive. They asked questions and wanted correct information. He also mentioned that they enjoyed playing games, watching demonstrations, touching equipment and participating.

When he mentioned that the learners' behaviour had changed, he was asked about the effect his learners' changed behaviour had had on his classroom practice. He responded by saying, "Ok…the participation of the learners is high you understand and also when you give them the work you have no stress, because they will do it, you understand and also when you give them work. They will indicate when they need assistance". This response indicated that Mr Mashangura was no longer worried about learners who would not do the tasks given to them. This is also an indication of positive outcomes from learners, and that it has reduced his "stress" level. He claimed that learners would indicate to him when they required assistance. Mr Mashangura did not comment on learner performance.

6.4.1.6 Professional Identity

As depicted in Table 4.6, teacher confidence, beliefs, attitudes and collaboration categories were grouped under the theme professional identity. Teacher confidence was coded in several responses in the transcript of Mr Mashangura's interview. This indicated that he was confident as a science teacher in various ways. Mr Mashangura's confidence was observed when he was asked if he had sufficient subject knowledge to teach NS and practical skills to do the prescribed activities. In both cases, he responded with confidence and said "yes", but did not elaborate or justify his confidence. As already indicated, Mr Mashangura sometimes gave vague answers, for example, when he was asked how he decided which learning activities to use in a lesson, he responded confidently about the importance of the teaching approach and did not respond to the choice of learning activities. In another instance, he responded vaguely when required to mention one scientific concept he thought he had learnt.

Mr Mashangura's confidence was observed when he explained that theories of learning had helped him change his classroom practice. His confidence was also observed when he responded to the question as to whether he thought his subject knowledge had improved, he said "Definitely". Similar confidence was observed when he was asked if he had more confidence in teaching science, to which he replied "Yes". When was asked how confident he was in sharing what he was taught in the ACE programme with other teachers in the cluster he said: "In the cluster we plan together as a cluster, we set common paper together setting exams and tests together. I enjoy it, I was a cluster leader first but now I had lot of job, and also a leader of some kind and ehh." He answered confidently that he used to be a cluster leader but had resigned when the school selected him as a coach in sporting activities. However, he said that he still shared in the cluster. He confidently said, "I am a leader for rugby in the school".

Teacher's beliefs appear several times in Mr Mashangura's interview transcript. His remarks reflected a belief that practical work supports learning science. He believed that sensory experiences enable learners to learn science, saying "maybe by touching and feeling." In another question where he was required to explain what he thought learners enjoyed in class, he reiterated similar responses related to "...touch things and feel things." It seems he believed in being well prepared before going to class and in planning because he said "... you cannot go to class without planning." It was concluded that Mr Mashangura's beliefs were formed during the ACE programme because he indicated that he enjoyed teaching, and carrying out investigations subsequent to his participation in the programme. He also said, "...even learners who do not cope understand to explain further the investigation". Mr Mashangura believed that the learners who did not understand what he taught would understand when exposed to practical activities.

Although he did not have sufficient apparatus to do investigations, his attitude was positive as he would request learners to bring something from home. Mr Mashangura did not avoid doing investigations because of a lack of apparatus; this was as a result of his positive attitude. Instead, he requested learners to bring materials from home, or he would go round the school looking for resources to improvise. Mr Mashangura had a positive attitude regarding leadership in the cluster, as well as in sport. Furthermore, his positive attitude was observed towards the ACE professional development programme: "Eh…the thing which I can say first of all I would like to thank our government for giving us this opportunity and I say in future our government must keep on developing us with another mechanism which they can do". This indicated that he had a positive attitude and was inspired to enrol in a similar programme in the future.

Issues of collaboration were noticed and coded in Mr Mashangura's interview transcript. He was confident in sharing what he was taught with other teachers in the cluster, saying "In the cluster we plan together as a cluster, we set common paper together setting exams and tests together". The impression was that they worked together in the cluster to plan and to set common papers. Mr Mashangura was later in the interview asked if he was willing to share what he had learnt in the ACE programme, to which he replied "yes", indicating that he did not have a challenge in working with other teachers.

6.4.1.7 Programme outcomes

As indicated in Section 6.3.1.7, all responses related to the envisaged and attained outcomes of the ACE programme were categorised under the theme programme outcomes. Mr Mashangura was asked questions about his understanding of the outcomes of the ACE programme. He was asked what he thought the DoE wanted him to learn from the ACE programme, he said, “It to upgrade my qualification and also to have more knowledge of teaching.” He did not spell out the outcomes as reflected in the documents of the DoE, nor did he express an understanding of the envisaged outcomes, apart from “...more knowledge”, repeating it three times. What he thought the Service Provider wanted him to learn from the ACE programme was not similar to the Service Provider’s documents, he said “To further my own professional deve deve…lopment and help me to meet the challenge of the teaching and learning”. He did identify it as it stands in the document of the Service Provider, but rather gave his understanding of the outcomes of the ACE programme. Mr Mashangura thought that discipline should improve and learners should participate after completing the ACE programme. This was his response when he was asked how he thought his classroom practice was expected to change after completing the ACE programme.

The attained outcomes of the ACE programme were revealed when he responded to questions on lesson planning, “They support me and develop me they give a lesson development frame to do lesson preparations.” Clearly, Mr Mashangura had learnt about lesson planning from the Service Provider, which impacted his classroom practice. As indicated in Section 1.4, this was a template for lesson planning that was found during the document analysis of his file. He was also requested to share something he had been taught in ACE that he practiced in class, to which he replied, “The role of learners under constructivism eh. There is an acting learner. The learner participates and understands in class. There is a social learner working in groups. There is a creative learner. The learners participate in class. I also learnt about theorist like abo-Vygotsky”. Mr Mashangura seemed to have learnt about learning theories in the ACE programme.

Finally, when he was asked to name a specific concept that he enjoyed from ACE, he mentioned planning and at the end of his response he said, “I have gained a lot from the ACE programme”. He did not explicitly mention other lessons learnt from the ACE programme in this response. However, he later indicated what he had gained, saying “I gain experience on how to plan. Assess investigation, and also form of assessment, also using rubrics”. He gave this response when asked to explain how the ACE programme had changed the way he believed in and viewed himself as a science teacher. It was found from this response that other than learning how to plan, he had also learnt to use rubrics in the ACE programme.

When asked if he enjoyed teaching science more than before completing the ACE programme, he cautiously replied “No, before you said before going to ACE now not have enough skills”. This sounded like a contradiction, as he had earlier indicated that he learnt a lot. Perhaps he feared that it might be interpreted as though he was not good enough before completing the ACE programme. It was observed from his earlier responses that he had learnt from the ACE programme. At the end of the interview Mr Mashangura indicated that he appreciated the opportunity to have participated in the ACE programme, saying: “...our government must keep on developing us with another mechanism which they can do”. It is in this response that he was in fact prepared to admit that the ACE programme had developed his skills.

6.4.1.8 Summary of the interview

Mr Mashangura attempted to answer all the questions asked during the interview, but as indicated, he gave vague answers to some of the questions. However, responses to such questions provided data that was used elsewhere in this thesis. When Mr Mashangura was interviewed, he demonstrated an understanding of the way his classroom practice was expected to change after completing the ACE programme. He indicated that he had sufficient subject knowledge to teach the syllabus in NS, and that his subject knowledge improved after completing the ACE programme. The content he struggled to teach was due to the lack of a laboratory in the school, not a lack of knowledge. Although he indicated that the apparatus were insufficient, he reflected a willingness to conduct investigations for learners using improvised apparatus. As indicated, he said he would request learners to bring from home the familiar apparatus. Furthermore, Mr Mashangura believed that his classroom practice had changed because he planned his lessons and he accommodated the different learning styles of learners in his teaching by providing teaching aids, such as pictures. Mr Mashangura explained that he considered learning theories as important to teaching, and that they impacted his classroom practice.

He believed that learners who struggled to understand what he taught could be assisted by doing practical activities. He believed that learners should “touch” and “feel” to be able to learn science. He also believed in using group work and discussion. He viewed his learners' changed behaviour, including their inquisitiveness and motivation, as an indication that they had changed since he completed the ACE programme. His professional identity seems to have been impacted positively by the ACE programme as he was willing to share what he was taught in the cluster. He stated that he collaborated with other teachers in the cluster to set common papers and this confirms that he was confident as a science teacher even before completing the ACE programme.

When interviewed, Mr Mashangura was comfortable in explaining how he perceived changes in his classroom practice. He indicated that he learnt a lot from the ACE programme, and mentioned lesson planning specifically. Mr Mashangura did not want to be seen as someone who was inadequately trained before completing the ACE programme, although he was prepared to say that he was "developed" by the programme. He understood that the DoE wanted to upgrade his qualifications so that he acquired more "knowledge of teaching". He certainly understood that the Service Provider wanted to develop his teaching skills.

6.4.2 Lesson observations

Mr Mashangura's lessons for natural sciences Grade 7 were spread throughout the timetable of the school. Some lessons were offered in the morning and some in the afternoon. For this study, six lessons were observed. In some lessons, he taught for 30 minutes and the rest of the time, learners wrote and conducted practical tasks, but in the third lesson he taught the whole hour facilitating one activity after the other.

Table 6.2: Summary of the findings of Mr Mashangura's lessons

Lesson no.	Topic	Duration of the lesson	Findings	
			Learners' actions	**Teacher's actions**
1	Mixtures	1 hour	✓ Read notes from the board simultaneously ✓ Engaged in hands-on activities making mixtures ✓ Group leaders presented on behalf of the group how the mixtures were made. ✓ Copied homework on their workbooks	✓ Explained the notes on the board as learners read ✓ Demonstrated the separation of oil and water ✓ Wrote homework on the chalkboard for learners to copy on their workbooks
2	Separation of mixtures-chromatography	1 hour	✓ Presented mixtures they made the previous day ✓ Copied in their workbooks notes on chromatography	✓ Requested learners to share if mixtures they made the previous day could be separated and how ✓ Explained to learners notes on chromatography and they were written on the board
3	Methods of separating	1,5 hour	✓ Separated the mixtures they made in the first lesson ✓ Answered questions posed by the teacher on	✓ Instructed learners to separate mixtures made in lesson 1

<table>
<tr><th rowspan="2">Lesson no.</th><th rowspan="2">Topic</th><th rowspan="2">Duration of the lesson</th><th colspan="2">Findings</th></tr>
<tr><th>Learners’ actions</th><th>Teacher’s actions</th></tr>
<tr><td></td><td>mixtures</td><td></td><td>chromatography
✓ Conducted the experiment on chromatography
✓ Each group leader presented the results of the investigations to the whole class.</td><td>✓ Allowed learners to read notes on chromatography again
✓ Asked learners questions based on the notes
✓ Clarified the steps to follow
✓ Allowed learners to conduct the experiment on chromatography
✓ Supervised learners as they were doing the experiment and consolidated the lesson.</td></tr>
<tr><td>4</td><td>Recycling</td><td>1 hour</td><td>✓ Answered questions posed by the teacher
✓ Picked up thrash in the school yard then converged to sort according to the criteria selected by the group
✓ Group leaders presented and explained the criteria used to sort the thrash.</td><td>✓ Asked question related to recycling
✓ Clarified the recycling activity to executed outside the classroom
✓ Divided learners into 2 groups
✓ Supervised learners as the activity was done</td></tr>
</table>

Lesson no.	**Topic**	**Duration of the lesson**	**Findings**	
			Learners' actions	**Teacher's actions**
5	Force	1 hour	✓ Responded to the questions asked orally ✓ Listened as demonstration progressed ✓ Cooperated as demonstration progressed as some learners were used to demonstrate	✓ Asked learners questions about the concepts of force ✓ Conducted a demonstration using magnets ✓ Explained notes previously written on the chalkboard on the seven effects of force ✓ Demonstrated the seven effects of force ✓ Gave learners a handout that contained an activity to be written as homework.
6	Electricity	1 hour	✓ Responded to questions asked orally ✓ Copied from the board the homework given	✓ Introduced the lesson through questioning and questions were based on the previous lesson ✓ Drew components of electrical circuits on the chalkboard ✓ Gave learners homework to do

6.4.2.1 Narratives of the lessons observed

Mr Mashangura's first lesson observed was on mixtures. This lesson consisted of three distinct parts. In part one, the learners read notes from the chalkboard and he explained the notes as the reading progressed. In part two, learners were engaged in hands-on activities where they made mixtures using the ingredients they brought from home. Part three was where he demonstrated the method of separating a mixture of oil and water. Part one started by allowing learners to read the notes from the chalkboard. The notes on mixtures were read by all the learners simultaneously. As the reading progressed, the teacher stopped them and explained each key concept on mixtures. Terms like pure substance, solution, solute, mixture and solvent were explained.

Thereafter, part two commenced, engaging learners in hands-on activities. Mr Mashangura gave learners clear instructions of what to do when making the different mixtures. The learners brought different substances from home for the purpose of this practical activity. Among the substances brought from home were beans, samp, rice, salt, sugar and mealie-meal. Groups were expected to make mixtures of their choice and they were told that when done, each group leader should come to the front of the class and explain how the mixture was made. There were five groups in the classroom and each group had its own group leader. Part two was concluded when the teacher explained to learners that some of their mixtures could be separated.

Mr Mashangura then introduced part three of the lesson by informing learners that there were different methods of separating mixtures. He told the learners that he was going to conduct a demonstration on the separation of the mixture of oil and water. Mr Mashangura brought engine oil from home, he made a mixture of water and oil, after which he prepared a container to separate this mixture. He used an empty two-litre bottle with a hole at the bottom. Then the demonstration was done with the assistance of two learners while the rest of the learners observed how the mixture was separated using the improvised apparatus. After the demonstration was done, the separated substances were shown to all of the learners. This lesson was concluded by giving learners homework from the teacher's reference textbook. The homework given to the learners was part of the notes Mr Mashangura wrote on the chalkboard. Learners were required to copy this into their workbooks. The questions in the homework were required learners to explain the terms related to mixtures.

Mr Mashangura's second lesson was on the separation of mixtures using a method called chromatography. In this second lesson, he started with a revision of the previous lesson that dealt with mixtures where learners mixed food brought from home. Learners were selected to come to the front to present to the whole class the mixture made the previous day, and they were expected to share how their mixture could be separated. As each group presented, Mr Mashangura corrected them instantly whenever they mentioned in their presentation an incorrect method of separating their mixture. After all the groups presented, he explained to the learners the notes that were written on the board on chromatography. He completed this lesson by explaining to the whole class how they should go about conducting the experiment of chromatography. The learners were informed that the actual experiment on chromatography was to be conducted in the next period, which was his third lesson.

The third lesson included two activities. The lesson commenced by revising the different methods used to separate mixtures. Thereafter, learners were allowed to separate the mixtures they had made during the first lesson. The mixtures presented by the different groups were a mixture of water and samp, sugar and samp, beans and tomato sauce, water and sugar. All of the groups attempted to separate their mixtures using a sieve, decanting, and by hand. The teacher did not confirm whether they were using correct methods, instead he started with the actual lesson on chromatography. The learners had to read notes about chromatography all over again, these notes were still on the board from the previous lesson. While reading, the learners were involved in the lesson by answering questions posed by the teacher. These questions were based on the notes they were reading. The learners then worked in groups conducting the experiment on chromatography. As the learners were engaged, the teacher moved from group to group supervising. He further clarified the steps learners were to follow in conducting the practical task on chromatography. All of the groups were actively involved under the leadership of the group leader. There was a lot of enthusiasm displayed by all of the groups as they performed the practical activity. After all the groups had separated the ink into different colours, each group was expected to present their product to the whole class. Thereafter, they had to explain to the whole class how chromatography was carried out in their respective group. The evidence of what each group did was shown to the whole class. As each group leader completed the presentation, the whole class applauded. The latter part of the third lesson was concluded by the teacher summarising the lesson, consolidating what all the groups had presented on the activity of chromatography. This was the longest lesson that Mr Mashangura presented.

Mr Mashangura's fourth lesson was an outdoor lesson. The topic for this lesson was recycling. The teacher started by asking learners questions that sought to establish learners' understanding of recycling. The teacher clarified the task that learners were supposed to do outside of the classroom. Learners were divided into two big groups. The teacher made the activity more interesting by grouping learners into boys and girls separately, and getting learners excited about the activity. The learners were then instructed to go outside and pick up the litter and trash in groups. Each group was allocated a rubbish bin to use in collecting waste around the school. As the picking up of waste was in progress, the teacher supervised the learners and he kept order by calling learners who seemed to be distracting others.

After approximately seven minutes, all groups were requested to converge on the school playground where sorting of the waste took place. Within five minutes, the sorting was completed and groups were expected to share how they sorted the waste and which criteria informed their sorting. As the group leaders presented, the teacher asked them questions that required learners to think deeper about the criteria used in sorting. The lesson was concluded by asking learners to name the importance of recycling. They were required to answer the questions orally while outside. The learners were required to take the rubbish bins back to where they had found them in the school yard. The photograph in Figure 6.8 depicts one group of learners commencing with the sorting of waste collected.

Figure 6.8: Learners sorting waste in the lesson on recycling.

Mr Mashangura's fifth lesson was on the concept of force. The notes on the effects of force were written on the board before the commencement of the lesson. At the start of the lesson, he asked oral questions to ascertain learners' understanding of the definition of force. He received different responses and finally consolidated all of the learners' answers. He then conducted a short demonstration using magnets, as seen in Figure 6.9, to illustrate the force of attraction and the force of repulsion. Mr Mashangura wanted learners to be able to remember the difference between the force of attraction and the force of repulsion. He placed the same poles of the magnets together so that the magnets moved away from each other. Subsequently, he placed the opposite poles of the magnets close together so that the magnets moved closer to each other.

Figure 6.9: Magnets used to demonstrate the force of repulsion and attraction

Thereafter, Mr Mashangura explained to the learners the notes previously written on the chalkboard. He made sketches of magnets as he explained the notes. He also demonstrated the seven effects of force, namely, force can change an object's direction of motion, or can change shape, or can change speed. Forces can also be balanced; can twist an object; can cause an object to move and to rotate. The teacher conducted a demonstration of these effects of force using some of the learners in front of the class. He further linked the demonstration with the notes written on the board. The second level of demonstration was observed when he wanted to assess whether all of the learners were following the explanation of the content. He then used the magnets again, pushing similar poles of the magnets closer as well as opposite poles. The learners were then expected to indicate the kind of effects of force that were demonstrated. As he continued the demonstration, the teacher realised that the learners gave incorrect answers, so he started over again in demonstrating and explaining the effects of force. The learners seemed to understand when this was explained the second time. This lesson was concluded by giving learners a handout that Mr Mashangura had copied from his reference textbook. The handout had questions, sketches and pictures where learners were to indicate which effect of force was applicable in each case. Finally, Mr Mashangura explained the activity in the handout before learners were required to do the individual activity as homework.

Lesson six was on electricity, and Mr Mashangura introduced the lesson by revising the lesson on magnets and force. Learners were selected to come and demonstrate the force of attraction and the force of repulsion using magnets in front of the class. Subsequently, the topic on electricity was introduced when he asked learners to mention any electrical appliances used at home. Thereafter, Mr Mashangura requested the learners to mention the components of electrical circuits. As the learners mentioned cells, bulbs, switches and resistors as components, the teacher drew on the board a symbol and wrote the name of the component. He then started to draw sketches of electrical circuits on the board and for each sketch made, a corresponding circuit diagram was drawn. The lesson developed this way to the extent that learners were taught series and parallel circuits. The lesson was concluded by giving learners a homework activity. The homework activity was sourced from Mr Mashangura's reference textbook, from which he made copies and gave to the learners as handouts. In this homework activity, learners were requested to draw different circuit diagrams from the pictures provided in the handout.

6.4.2.2 Analysis according to the observation schedule

The data collected from the lesson observations was analysed in terms of the main elements covered by the observation schedule. The elements were: teacher's subject knowledge, practical competence in conducting experiments, pedagogical skills, languages skills, and lastly, teacher's beliefs about and attitudes towards teaching science.

Subject knowledge

Mr Mashangura presented the subject knowledge in detail and explained the content correctly. In most of the lessons, he provided learners with notes that were relevant and factually correct. He sometimes used suitable demonstrations, which indicated that he had a good understanding of the subject knowledge. It was interesting to observe that Mr Mashangura's learners did not ask questions related to the content in any of the six lessons presented. It is possible that he presented the content in such a way that the learners understood his explanations. There may be other reasons too, for example, the learners might not have been used to asking questions, or the presence of a researcher in the classroom may have discouraged them from asking questions.

Practical competence in conducting experiments

In all of the investigations conducted, Mr Mashangura selected the appropriate apparatus beforehand. He also requested in advance that learners bring some items from home. In the first lesson, learners were required to bring to school ingredients to make mixtures of their choice. Mr Mashangura also planned well in advance to conduct a demonstration where he separated oil and water, bringing motor oil and an empty bottle from home.

In the third lesson, ink and filter paper were organised in advance for learners to use during group work. The fourth, fifth and the sixth lessons were not planned as practical lessons, therefore, there was no need to prepare resources or apparatus in advance. Mr Mashangura clarified the purpose of the investigations conducted. In the first lesson, he explained that the purpose of the experiment was to make mixtures, then later separate them where possible. In the third lesson, the purpose was stated as separating different mixtures. Here, the mixtures made during the first lesson were separated first, followed by the chromatography where the different colours in the ink mixture were separated. It was concluded that the learners understood the purpose of the investigations as they did not experience any difficulties in performing the investigations.

Checking apparatus beforehand for functionality was not relevant in most of the practical activities that were presented as standard laboratory equipment was seldom used. Learners brought items from home for the first lesson. Mr Mashangura brought engine oil from home too. He prepared the improvised apparatus used during the separation of oil and water in front of the learners for them to observe. This was probably intentionally done to teach learners how to make improvised apparatus to separate oil and water. However, the beaker, sieve, and filter paper for the separation of mixtures were from the school’s equipment and were prepared in advance.

There were no printed worksheets prepared for the practical lessons. In the first and the third lessons, the worksheets were part of the notes written on the board. Learners were required to copy the worksheets into their workbooks. In both cases, learners knew what they were supposed to write in the worksheets because Mr Mashangura had explained it to them. In the first lesson, they were supposed to write the definition of terms, and in the third lesson they were supposed to write the different methods used to separate mixtures. The source of the worksheets was Mr Mashangura's reference textbook. The worksheets did not really assess the practical work conducted, but rather the content used for the hands-on activities, for example, making mixtures was not described in the worksheets; instead the definitions of terms were required.

Mr Mashangura conducted a practical demonstration showing learners how the mixture of oil and water is separated. The demonstration was visible to all of the learners. There were 41 learners in Mr Mashangura's classroom. He conducted the demonstration standing for all the learners to see. The learners were required to orally describe the method the teacher used to separate oil and water. The demonstration activity was not assessed in this lesson. Similarly, in the fifth lesson, a demonstration was conducted by Mr Mashangura. As already indicated, he demonstrated the effects of force using learners in the classroom. He was a tall teacher and conducted the demonstration standing so that all of the learners could see what was demonstrated. After seeing the demonstration, the learners were required to answer questions on the effects of force. Handouts with pictures depicting the different effects of force were given to the learners to do as homework. They were expected to answer the questions in their workbooks.

Pedagogical skills

Mr Mashangura demonstrated a range of pedagogical skills during the presentation of his lessons. These are discussed below according to the criteria listed in the observation schedule. The presence of the following skills were observed: continuous assessment, classroom management, constructivist approach, interaction with learners, learner participation, cooperative learning, and accommodating different learning styles. During these lessons, three skills that were anticipated were not observed, namely, using models, using discrepant events to clarify further for learners, and addressing misconceptions.

Mr Mashangura demonstrated that he understood that continuous assessment was important to learning. While the learners were reading notes from the board during lessons he often interrupted, asking questions to assess their understanding. In the first, fifth and the sixth lessons, he used oral questions to assess learners' understanding of what was taught. Learners were given homework in the first lesson to define the terms associated with mixtures. In the fifth lesson, learners were asked orally to name the effects of force. In the sixth lesson, learners were asked to name the electrical appliances they knew.

The majority of the lessons that Mr Mashangura presented were practical lessons where learners conducted hands-on activities. These lessons had the potential of increasing the disciplinary problems of learners. However, this was not the case in the lessons presented by Mr Mashangura. He managed the stages of his lessons well, as was the case in the third lesson where he had carried out three activities. The three activities in lesson three were firstly, learners doing presentations, secondly, he conducted a demonstration, and thirdly, learners were engaged in the activity. He managed time well for each activity in the lesson. His classroom was well managed because there were no disciplinary problems observed in any of the lessons. In the first lesson, none of the learners spilled the mixtures made, as he managed the practical and the materials well. In the second lesson, the learners presented the mixtures made in the first lesson and the teacher was in control. In the third lesson, the presentations from the group leaders were also well managed because there was order. The fourth lesson, as indicated, was an outdoor lesson; learners could have misbehaved and ran around. This did not happen as the classroom was well managed.

Mr Mashangura related what he taught to real life examples. In the first and the second lessons, learners brought food from home to make mixtures, which indicated to learners that resources used to learn science can be found in real life, which includes their homes. Decanting and sieving as methods of separating mixtures were found to be familiar to what their parents or they sometimes did at home. In the fourth lesson, the teaching of recycling was related to the business of recycling waste. In the fifth lesson, a real life example of the effect of force was given and a car accident was mentioned as an example. Also, in the sixth lesson, the advantages of series and parallel circuits in real life were cited. It can be concluded that Mr Mashangura related real life examples to the teaching of scientific content.

Mr Mashangura utilised constructivist principles when he linked the learners' prior knowledge and context before commencing with a new lesson. In most of the lessons, Mr Mashangura started by briefly revising the previous days' lesson to enhance learning. The series of lessons on mixtures clearly demonstrated his use of constructivist principles. In the first lesson, the learners made mixtures themselves, using materials that they were familiar with, having brought it from home. Later, in lesson three, they had to separate those very same mixtures. He also demonstrated the separation of a mixture of oil and water, two substances that are well known by the learners. After this, the learners were equipped to understand that ink is a mixture of different colours when they performed the chromatography task. In the lesson on the recycling of waste, he compared waste with a kind of a mixture to be separated. This comparison linked the lesson on recycling with mixtures learnt previously. In this sequence of activities, learners constructed knowledge about mixtures and separation.

It was observed that Mr Mashangura interacted well with learners in all of the lessons presented. This was observed because learners actually answered the questions that Mr Mashangura posed. They followed instructions and cooperated with him, and listened when notes were explained. The learners were disciplined and when the teacher used some of them in the demonstration of the effects of force, they seemed to be relaxed and interested in the lesson.

The learners were actively involved in all of the lessons that Mr Mashangura conducted. They were either answering questions or conducting practical activities. In instances where the learners worked in groups, the group leaders presented the findings in front of all the other learners. The teacher gave them opportunities to seek clarity through questions, which they did not use. In the first lesson, the learners answered questioned and presented their mixtures. They were actively involved in different ways, for example, in the second lesson they read notes and answered questions. In the third lesson, the learners handled apparatus and conducted hands-on activities. In the fourth lesson they collected, sorted the waste and responded to the questions asked by the teacher. In the fifth and sixth lesson, they participated in answering questions.

Mr Mashangura's pedagogical skills were also observed when he engaged learners in hands-on activities that better clarified scientific concepts. In the first lesson, learners made mixtures and Mr Mashangura demonstrated the separation of oil and water. In the second lesson, learners presented the mixtures made in the previous lesson. In the third lesson, they used sieving and decanting for separating mixtures. Chromatography followed later during the lesson. Mr Mashangura used pictures and models when teaching science. In the fifth lesson, Mr Mashangura used pictures to illustrate the effects of force and also used learners to perform the demonstrations. In the sixth lesson, he used circuit diagrams and sketches resembling pictures of electrical circuits.

When Mr Mashangura's lessons were observed, it was noted that during cooperative learning, learners were involved in hands-on activities. The learners worked in groups when they made mixtures from the materials brought from home, and later when they separated these mixtures, when they separated ink colours by chromatography and also worked in groups when they collected and sorted waste. In these lessons, cooperative learning was observed because the learners worked together.

Different learning styles were incorporated in Mr Mashangura's lessons. Notes were read from the board during the presentation of most of the lessons. These reading activities favoured learners who learnt best when reading. In two of the lessons, learners were given an opportunity to present the results of their activities and this accommodated learners who learn best by explaining to others. Learners who are kinaesthetically oriented and learn best by doing and solving real life problems benefitted from the various practical activities. Learners who are visually orientated were favoured by the demonstration on the effects of force. One may conclude that the various learning styles were accommodated in Mr Mashangura's lesson.

Mr Mashangura used different teaching strategies, which accommodated the different learning styles of learners. In the first and third lessons, he used group work as well as questions and answers during discussions. He also read notes from the chalkboard. In the second lesson, reading notes was used and he asked learners oral questions. In the fourth lesson, group work, as well as questions and answers were used as the teaching strategies. In the fifth lesson, questions and answers, reading notes, as well as demonstration were used. In the sixth lesson, there was direct teaching, as well as oral questions that were used as teaching strategies. Direct teaching was one of the teaching strategies he used. In the first lesson it was reasonably used as group work was the main strategy used. In the second lesson, direct teaching was used more than any other strategy since the learners read notes and the teacher explained these as the lesson progressed. In the third and the fourth lesson, it was limitedly used as group work dominated these lessons. In the fifth and the sixth lessons, direct teaching was done reasonably well. In between the direct teaching, learners were asked questions.

Mr Mashangura asked the learners questions that covered different cognitive levels in the different lessons. In the first lesson, he asked learners: "what is a pure substance", "what is a solution", "what is a solute", "describe a mixture", "what is a solvent". In the second lesson, the questions asked were, "explain what you have mixed", and "name different types of methods to separate mixtures". In the third lesson, learners were to "describe how ink was separated". In the fourth lesson, the uses of recycling were asked. In the fifth lesson, learners were asked to define force and to describe the effects of force. In the sixth lesson, the learners were asked to give examples of electrical appliances and to draw circuit diagrams corresponding to the given pictures. Most of these questions were on a lower cognitive level, but there were also higher order questions that required learners to apply knowledge.

Language skills development

It was observed that Mr Mashangura wrote notes on the board before the lessons commenced. Thereafter, he requested the learners to read the notes and, as they read, Mr Mashangura explained the content in details. Reading the notes seemed to enhance the reading skills of the learners. The learners who did not pronounce certain words in the notes correctly were corrected. Mr Mashangura explained scientific concepts for learners in English. He was the only teacher in the study who never code-switched, yet and the learners still understood what he taught. It was evident that the learners understood the explanation in English because they were able to write the activities given as classwork and homework, and got the answers correct.

Beliefs and attitudes

Mr Mashangura displayed a lot of confidence in the presentation of all the lessons. He explained the scientific concepts without referring to a textbook or notes. He did not read from the prepared lessons; he only looked at the lesson preparation at the beginning of each lesson. It seems that he was well prepared and passionate about teaching science. He also displayed a positive attitude when he had to re-explain the concept of the effects of force to learners who did not understand the first explanation. It was concluded from Mr Mashangura's involvement of the learners in activities that he believed that learners learn best by doing. This could be the reason why the six lessons he presented were mainly activity-based.

Mr Mashangura was enthusiastic, patient and he clarified scientific concepts further each time the learners did not understand, for example, in lesson 5, when he realised that the learners had given incorrect answers to questions about attractive and repulsive forces, he repeated the explanations. He motivated the learners to answer questions, to conduct hands-on activities, and to present their findings in front of other learners in the classroom. It was clear that he wanted his learners to understand and enjoy science.

6.4.3 Document analysis

The document analysis was conducted to collect the data required to address the research question. The presentation and discussion of the document analysis is according to the elements of the document analysis guide. The analysis of the learners' workbooks is presented first, followed by Mr Mashangura's documents and records.

6.4.3.1 Learners' workbooks

The analysis of the learners' workbooks was conducted in terms of the five elements in the document analysis guide. These elements were: activities based on practical work; the frequency of written work; accuracy of feedback given to learners by the teacher, activities that require higher order thinking, and evidence of various forms of assessment given to learners. Three learners' workbooks were selected by the teacher after each lesson was observed, which were then analysed by the researcher. The analysis will be discussed in this section.

Activities based on practical work

Learners' workbooks reflected a variety of written tasks. Activities based on practical work were also found, however they were few. There were a total of 39 written tasks from January to August, of which only four were written work based on practical work. The practical activities were: making a model of a volcano; making mixtures; separating mixtures and recycling waste. It was noted that three of the four practical activities were conducted during the observations in August. Similar to Mr Wakithi's case, the practical work conducted during lesson observation period were viewed as specifically conducted because the teacher was aware that he was under investigation. This demonstrates the Hawthorne effect as explained by Leonard & Masatu (2006). The rest of the activities were not based on practical activities. Activities, such as: to classify the following animals; to complete the following sentences; and to study the diagram then answer questions dominated the learners' workbooks.

The frequency of written work

The frequency of the written work found in the learners' books varied from month to month, as found in their workbooks. It was found that in January, the learners' workbooks reflected five examples of written work, four in February, four in March, four in April, eight in May, four in June, three in July, and seven in August. There was no particular pattern of giving learners written work that was established, except that schools re-opened late in July, therefore, few written activities were found in the learners' workbooks for this month. In contrast, in January, where learners had five written work examples, there were only two weeks of school. Therefore, the frequency of giving learners written work was not consistent.

Accuracy of feedback given to learners by the teacher

It was found that there was feedback given by Mr Mashangura in each learner's workbook that was analysed. It was found that the learners marked their own tasks in the workbook. Some learners used red pens and some used pencils to mark for themselves. There was evidence that Mr Mashangura signed the feedback as an indication that he had control checked their books. There were correct answers found from the feedback that he had given the learners. It was thus concluded that Mr Mashangura was accurate in giving learners feedback, and that he had appropriate subject knowledge.

Activities that require higher order thinking

A variety of activities were found in the learners' workbooks. Some activities required higher order thinking, and some lower order thinking. An example of higher order thinking was an activity where the learners were required to explain how they would separate the mixture of rice and beans. In the other activity, the learners were required to read the given pictures, then describe the effects of the forces demonstrated. Most of the activities in the learners' workbooks required lower order thinking.

Evidence of different types of assessment activities given to learners

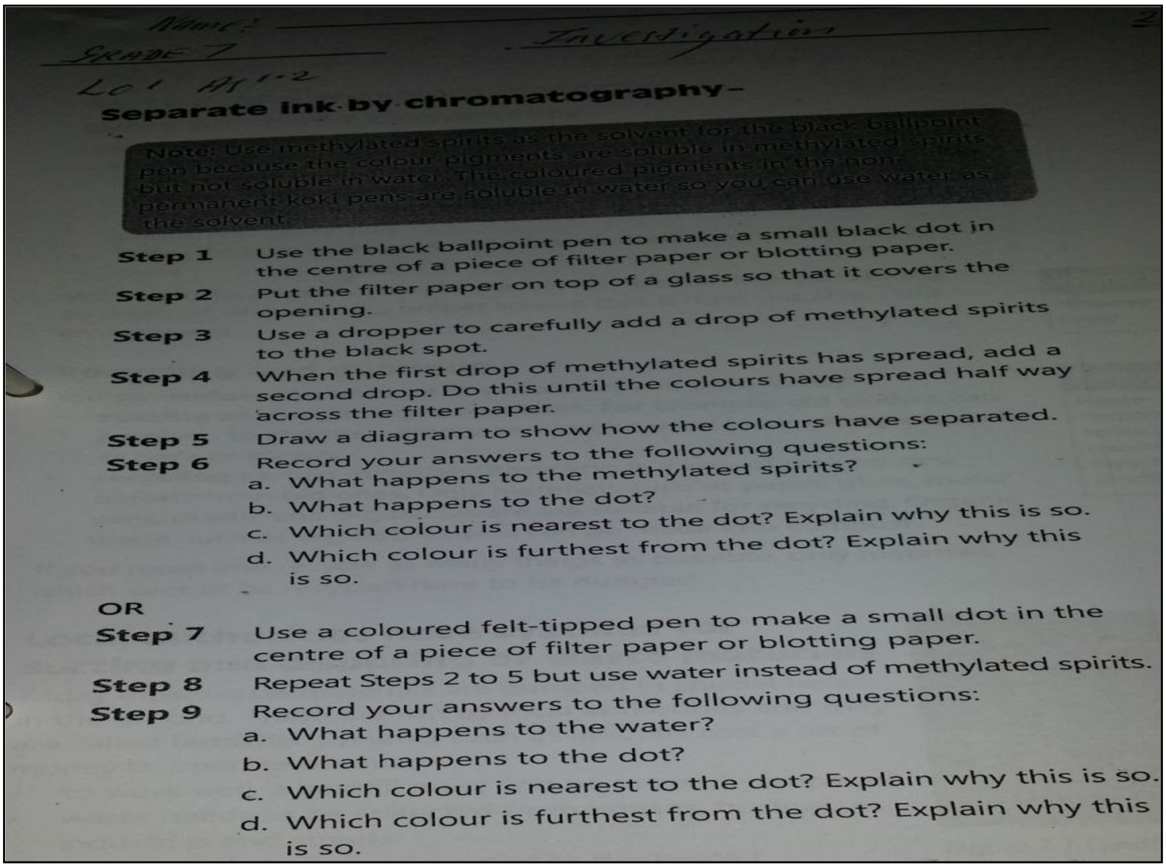
The analysis of learners' workbooks indicated that learners were given different types of assessment activities. There were translation tasks, investigations, assignments and tests found in the learners' workbooks. In one activity on electricity, learners drew the circuit diagrams from the illustrations that the teacher had given to them in the form of a handout. There were also questions where learners were required to describe in words what they saw in the picture. In the activity on classifying animals, learners investigated the kind of animals in the school yard, and later classified the animals into vertebrates and invertebrates. Learners were therefore given different types of assessment activities, as reflected by the examples in their workbooks.

6.4.3.2 Analysis of the teacher's documents and records

The documents analysed included the work schedule, lesson preparations, and programme of assessment. Mr Mashangura had two files, one contained previous assessments and copies of handouts made for learners from his reference textbooks. The second file contained the work schedule, lesson preparations, and programme of assessment. The analysis focussed on the activities in the teacher's lesson planning file that involved practical tasks, scientific content covered for the grade in his planning, learners' assessment records planned for various learning styles, and recording sheets reflecting the marks of learners. The files were requested and analysed after each lesson observation in the school. These are discussed in detail in this section.

Activities in teacher planning that involve practical work

Mr Mashangura's planning documents contained handouts and a few worksheets. The worksheets comprised the practical activities on separating oil and water; separating rice and beans, as well as chromatography. These activities were all conducted during the observation of Mr Mashangura's lessons. One of the worksheets found in Mr Mashangura's file was about the steps used to guide learners in conducting an experiment on chromatography. This worksheet is depicted in Figure 6.10.



Name:
Grade 7
Investigation
LO 1 AS 1-2

Separate ink by chromatography

Note: Use methylated spirits as the solvent for the black ballpoint pen because the colour pigments are soluble in methylated spirits but not soluble in water. The coloured pigments in the non-permanent koki pens are soluble in water so you can use water as the solvent.

Step 1 Use the black ballpoint pen to make a small black dot in the centre of a piece of filter paper or blotting paper.

Step 2 Put the filter paper on top of a glass so that it covers the opening.

Step 3 Use a dropper to carefully add a drop of methylated spirits to the black spot.

Step 4 When the first drop of methylated spirits has spread, add a second drop. Do this until the colours have spread half way across the filter paper.

Step 5 Draw a diagram to show how the colours have separated.

Step 6 Record your answers to the following questions:

a. What happens to the methylated spirits?
b. What happens to the dot?
c. Which colour is nearest to the dot? Explain why this is so.
d. Which colour is furthest from the dot? Explain why this is so.

OR

Step 7 Use a coloured felt-tipped pen to make a small dot in the centre of a piece of filter paper or blotting paper.

Step 8 Repeat Steps 2 to 5 but use water instead of methylated spirits.

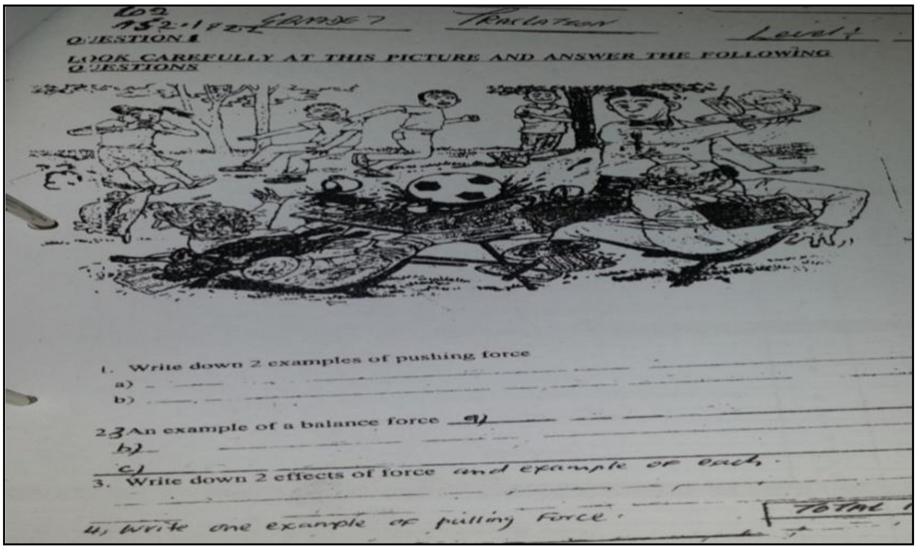
Step 9 Record your answers to the following questions:

a. What happens to the water?
b. What happens to the dot?
c. Which colour is nearest to the dot? Explain why this is so.
d. Which colour is furthest from the dot? Explain why this is so.

Figure 6.10: Example of worksheet on practical activity-chromatography found in Mr Mashangura's file

Science content covered for the grade in the planning

There was a work schedule provided by the district in Mr Mashangura's file. The work schedule had ticks indicating the content already covered. Lesson plans in his planning file covered the scientific content for the Grade 7 level, as observed in the work schedule. The planning template used by Mr Mashangura was found to have a space for learners' activities and teacher's activities. Mr Mashangura's lesson plans also indicated that at the end of each lesson, the learners would be given an assessment activity. Figure 6.11 depicts an example of a handout on the content of force.


GRADE 7 TRANSLATION

Level 1

QUESTION 1

LOOK CAREFULLY AT THIS PICTURE AND ANSWER THE FOLLOWING QUESTIONS

1. Write down 2 examples of pushing force
   a)
   b)
2. An example of a balance force a)
   b)
   c)
3. Write down 2 effects of force and example of each.
4. Write one example of pulling force.

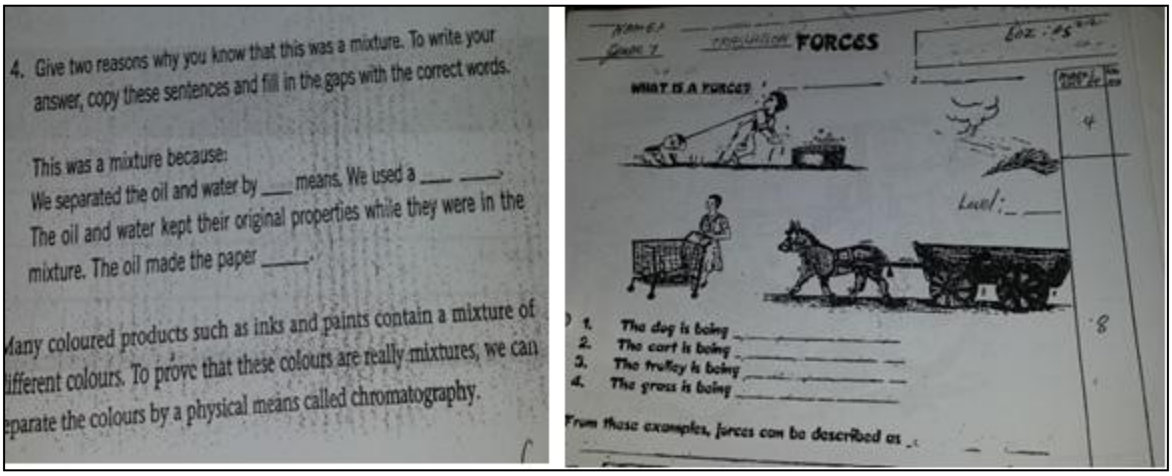
TOTAL

Figure 6.11: Example of handout with content on force found in Mr Mashangura's file

The scientific content covered included the prescribed core knowledge and concepts of natural sciences. The knowledge strands were: life and living, planet Earth and beyond, energy and change, as well as Matter and Materials. The departmental work schedule was developed such that the life and living content area was covered in the first term; planet Earth and beyond in the second term; Matter and Materials in the third term, and energy and change was allocated to the fourth term. According to the documents analysed, Mr Mashangura followed the same sequence that was observed in the departmental work schedule.

Learners' assessment records planned for various learning styles

The assessment records of the learners indicated that Mr Mashangura used various methods of assessment. Investigations, tests, translation tasks, and assignments were found in his file. In addition, there was a programme of assessment indicating the dates for the writing of a particular assessment for formal assessment purposes. Figure 6.12 depicts two examples of the assessment activities found in Mr Mashangura's file. In one type, learners had to fill in the answers, while in the other they had to interpret the pictures.


4. Give two reasons why you know that this was a mixture. To write your answer, copy these sentences and fill in the gaps with the correct words.

This was a mixture because:
We separated the oil and water by ___ means. We used a ___ ___.
The oil and water kept their original properties while they were in the mixture. The oil made the paper ___.

lany coloured products such as inks and paints contain a mixture of ifferent colours. To prove that these colours are really mixtures, we can parate the colours by a physical means called chromatography.

FORCES

WHAT IS A FORCE?

Level: ___

1. The dog is being ___
2. The cart is being ___
3. The trolley is being ___
4. The grass is being ___

From these examples, forces can be described as ___

Figure 6.12: Two examples of the assessment activities found in Mr Mashangura’s file.

Recording sheets for learner performance

Learners’ recording sheets were found in Mr Mashangura’s file. The recording sheets reflected the names of all the learners with the marks converted to a percentage awarded for each assessment. It was also observed that only the formal assessments were recorded in the recording sheets. The recording sheets indicated that learners’ performance was satisfactory ranging from 25% to 80%. Mr Mashangura followed the assessment policy because he recorded two formal tasks per term, as prescribed by the assessment policy aligned with the RNCS (DoE, 2004).

6.4.4 Summary of Mr Mashangura’s case

The three data collection methods were used as they were all important in addressing the research question. The interview was the first data collection method to be used, followed by the lesson observations and document analysis.

Mr Mashangura claimed during the interview that he had sufficient subject knowledge to teach science in Grade 7. He mentioned that he struggled to teach content because of the lack of a laboratory at the school. During the lesson observations, it was found that he presented and explained scientific content correctly. This was also confirmed in the analysis of the learners’ workbooks, where it was found that the correct feedback was given to learners. It was thus concluded that there was correspondence in the data collected using the three data collection methods with regard to subject knowledge.

Mr Mashangura believed that his practical skills could enhance the learning of science. He explained during the interviews that he used experiments to assist learners who struggled to understand what he taught. Indeed, it was observed during the lesson presentations that Mr Mashangura explained the content by engaging learners in hands-on practical tasks. He further used demonstrations to explain scientific concepts. It was observed from the learners' workbooks that they were given one activity based on practical work. He also mentioned during the interviews that he improvised by requesting learners to come with resources from home. The lesson observation confirmed this in the lesson on mixtures, where learners brought ingredients from home to make the mixtures. This indicated that learners had positive attitudes and there was enhancement of Mr Mashangura's professional identity. According to the theoretical framework the external domain, domain of practice and domain of consequence influence the personal domain where professional identity is located. As already discussed in Section 3.4 this result is illustrated by the reflective arrows 4, 8 and 7 of the theoretical framework (Clarke and Hollingsworth, 2002).

Mr Mashangura claimed during the interview that he could not go to class without planning his lessons. The document analysis confirmed this because it was found that there were lesson plans in his file. In addition, he mentioned during the interviews that the ACE Service Provider gave them a lesson plan template with the elements needed for lesson preparations. The template was found in his file, reflecting all the elements needed for the planning of the lesson. He also stated during the interview that he used teaching aids like pictures to explain to learners who did not understand what he was teaching. A number of handouts with pictures were also found in his file.

Mr Mashangura claimed that he was a confident science teacher, which was verified during the lesson observations. He displayed confidence and enthusiasm when explaining the content to learners. He stated in the interview that his classroom practice had improved after completing the ACE programme, referring to his pedagogical skills in implementing the knowledge acquired from the learning theories presented. There were no disciplinary problems observed in Mr Mashangura's class. The document analysis attested to this because the learners wrote sufficient activities, as observed in their workbooks. There was confirmation, to a large extent, of the claims made in the interview. This result is well explained by arrow 2 of the theoretical framework where arrow 2 as discussed in Section 3.4 is a link between the professional identity of teachers and their classroom practice (Clarke and Hollingsworth, 2002). The improvement in Mr Mashangura's domain of practice was because of his enhanced professional identity as opposed to the direct influence of what he learnt in the external domain, the ACE programme. This suggested that classroom practice improved because of the improvement in his knowledge, confidence and enthusiasm to teach science.

He mentioned during the interview that his learners asked questions with the purpose of challenging him to clarify content further. This was not observed during the lesson presentations. In none of the lessons presented did the learners ask questions, instead, Mr Mashangura asked them questions but once asked, the learners cooperated and responded with ease.

All in all, it can be concluded from this summary that there was agreement between the three data collection methods. It was only in a few instances where what was stated in the interview could not be observed in the data collected through the other instruments, for example, he stated that his learners had started concentrating in class so that they could ask questions, but this was not observed during the lesson presentations.

The most remarkable characteristic that Mr Mashangura revealed was that he never code-switched when teaching, and he learnt about the learning theories in the ACE programme. Mr Mashangura was also a cluster leader and later became a rugby coach in the school. This suggested that one cannot ascribe all of his confidence to the ACE programme that he had completed.

6.5 MR ZULU'S CASE

Mr Zulu's school was situated in a township. The school accommodated learners from Grades R to 7, and teachers in this school changed classrooms while the learners remained in the class. There was no laboratory in the school, and the few apparatus they had were stored in the cupboards of different classrooms. The lack of a laboratory is similar to the two cases already discussed, Mr Wakithi's and Mr Mashangura's case. Mr Zulu was a post level one teacher with 13 years of teaching experience in science. His qualifications were matriculation, the SPTD and an ACE in natural sciences.

6.5.1 Interview – presentation of data according to themes

6.5.1.1 Introduction

The interview with Mr Zulu took place in the computer centre where he normally spent his free periods. He suggested that his free period be utilised for the interview. It was conducted from eight to nine o'clock in the morning. The venue was conducive to an interview and he was comfortable in being interviewed.

6.5.1.2 Teacher's subject knowledge

Mr Zulu believed that he had sufficient subject knowledge to teach NS. This was observed when he repeated "yes" three times when asked if he had sufficient subject knowledge to teach NS. Mr Zulu confirmed this later in the interview when discussing how his learners enjoyed his classes, saying: "Now I am well equipped I can answer any questions as far as science is concern". He was further asked to give an example of subject knowledge in the syllabus that he found interesting or struggled to teach. He said, "Aih, there is no-there is no problem as far as everything is concern in science, the only challenge that I have is experiments." In his response there was no specific subject knowledge mentioned that was either interesting or that he struggled to teach. In the latter part of his response, he cited a lack of laboratory, which will be discussed in Section 6.5.1.3 as it relates to resource needs rather than teacher's subject knowledge.

Later in the interview he remarked, "Eh content or I am enjoying most of the practical like atoms, Matter and Materials, like those core knowledge I enjoy them all". Mr Zulu gave this response when asked to name a specific thing he enjoyed about the ACE programme. Also, he seemed to enjoy all of the core knowledge of NS, as indicated in the last part of his response. Moreover, he said, "Maybe I am teaching of something that I had to add my extra knowledge", which reflected that he was aware of the extra subject knowledge he had obtained. He was certain that his subject knowledge had changed. This certainty was confirmed when he was asked if he thought his subject knowledge had changed; he responded by saying, "Ja, it has changed drastically". It is clear that Mr Zulu was of the opinion that his subject knowledge had changed after completing the ACE programme.

6.5.1.3 Laboratory work

It has been indicated in Table 4.6 that the theme of laboratory work comprised practical skills, resource needs and improvisation categories. Mr Zulu was asked if he had sufficient practical skills to carry out the experiments. He said, “No, as I have explained that we do not have a laboratory and also the apparatus to perform those experiments”. From this answer, it is not clear whether he thought he had adequate skills. It does show that the lack of a laboratory limited his attempts to do practical work. He was further asked how often he did experiments with the learners, he did not answer this question clearly, instead he said “I suppose to do it once per term, maybe per quarter one experiment because we have four different strands”. He only responded regarding what was supposed to be happening, and not what was actually happening in his classroom. He later indicated that he had learnt a lot about the “practical part of science” from the ACE programme. Not having a laboratory does not mean that he did not have practical skills. However, from his response, it is not clear whether he did have practical skills, even though he said that he “learnt a lot about the practical part of science”. Mr Zulu was asked if he sometimes uses improvised materials to do experiments. He responded by saying “I do improvise” but he did not elaborate further at this stage to explain the kind of improvisation he had used previously. Then, later in the interview, he said “...I have to improvise do practical so that they can be able to see.” This was part of his response when he was asked to mentioned something he was taught in ACE that he practiced in his classroom.

Early in the interview, Mr Zulu was asked to give an example of subject knowledge in the syllabus that was interesting or that he struggled to teach. His response about the lack of a laboratory in the school has already been quoted in Section 6.5.1.3. Mr Zulu’s challenge in teaching science, as pointed out, was the lack of a laboratory in the school. His perspective was that he did not have challenges with the “rest in science”, except for the challenge of conducting experiments that seemed to be related to the unavailability of a laboratory in the school. In his own words, he said “We do not have a laboratory and also the apparatus to perform those experiments”. He indicated that they required whole science kits and said that these science kits have all the apparatus inside. In addition, Mr Zulu seemed to be overwhelmed by the lack of resources in the school. This was observed when he was asked what he had learnt from the ACE programme, to which he replied, “We don’t have facilities to make these learners do practical like teaching using computers. We have few computers.

We need computers I have 250 learners I must reach them all.” It can be deduced from this response that he also viewed computers as important equipment to help learners perform practical activities. Mr Zulu thought the availability of computers would enhance his classroom practice. He reiterated resource needs, saying “We have overcrowding, lack of resources like apparatus, laboratories and all those things”.

6.5.1.4 Pedagogical knowledge

The theme pedagogical knowledge, as shown in Table 4.6, comprises the categories of understanding how learners learn science, and pedagogical skills. Mr Zulu was asked to explain how he planned his lessons. He said, “I plan my lessons, eh, before-before I teach maybe two days before I teach, sometimes a day”. It was expected that he would describe how he planned his lessons. Consulting the current policy to check the curriculum needs in terms of learning outcomes and assessment standards was not mentioned. Mr Zulu only referred to the timing of planning. However, in another question, he indicated that he used textbooks and the internet to prepare for each lesson. He gave this response when he was asked to name the information sources he used to plan or prepare for each lesson.

He also displayed some pedagogical skill in responding to questions like how he decided which learning activities to use in a lesson, how he assisted learners who struggled to understand what he taught them, and how he accommodated learners of different learning styles. Changing the teaching strategy to group work was common in all the responses he gave to these questions. Mr Zulu also said that learners should be allowed to guess. Similarly, he mentioned hypothesizing when he was asked about a concept he had learnt from the ACE programme.

Understanding how learners learn science was coded several times in Mr Zulu’s interview transcripts, indicating that Mr Zulu displayed a good understanding of how learners learn science. He understood that learners must be given some activities to assess whether learning had taken place. In his own words, he said, “After I have taught, just to check that these learners understand.” This indicates that Mr Zulu understood that assessment is an integral part of good classroom practice.

Furthermore, he was asked to explain what he did when learners struggles to understand what he taught them. He said, “Ah - yi I use to divide them to check those who are slow so that I give them more activities and the intelligent one I give them more challenging activities”. It seemed that Mr Zulu changed his teaching strategy to assist learners who struggled to grasp concepts. It was concluded from his response that he understood that learners learn differently, and so grouping them according to their pace of learning could contribute in enhancing his classroom practice. This response did not address the question adequately. It is not clear why he gave the slow learners more activities seeing that they were slow, but there was the suggestion that the challenging activities were given to those who worked faster. Furthermore, he was asked how he accommodated learners with different learning styles. Mr Zulu maintained that he divide them into groups. His response indicated that he applied the same strategy for learners who struggled to understand what he was teaching, as well as to accommodate learners with different learning styles.

As already indicated, he was asked to share how he helped learners in understanding science when they had language difficulties. Mr Zulu's response indicated that he understood how learners learn when he spoke about the different home languages in his class. He helped learners to understand science when they had difficulty understanding the language by using code-switching: "Sometimes you had to code-switch but you mustn't do always because we have multi-classes here we have Pedis, Tsongas and Zulu languages. So, you must check which language suits them, there diverse languages sometimes use their mother tongue- just explain few words". It was concluded from his response that he sometimes code-switched to accommodate a particular home language in the classroom, but he seemed cautious in doing this because of the different home language speakers in his class. He indicated in the interview that he only explained a few words, probably in the mother tongue of some of the learners in class, and then would switch back to the LoLT.

He was also asked if he understood how learners learn in terms of the kind of experiences that he thought would enable learners to learn science. He said, "I think is to do practical, practical work more often can help these learners". He seemed to believe that exposing learners to practical activities enabled them to learn science. His response was similar to the other two cases already discussed. Mr Zulu understood that doing practical activities "more often" with learners is the kind of experiences he thought enabled learners to learn science. However, it seems that this seldom happened in his class due to the lack of apparatus and laboratory.

6.5.1.5 Learner outcomes

Mr Zulu was asked if his learners' behaviour in class changed after he had completed the ACE programme. He responded positively and further explained that previously, 60% of his learners obtained a "high mark", but after completing the ACE programme, he estimated it at "definitely 80 to 90". It therefore seemed that Mr Zulu's learners performed better. He also indicated that some of his learners had started to challenge him by posing questions to test his scientific knowledge, "There are learners that are challenging they pose a question whether they want to check how intelligent you are or they just test your knowledge in science." It was concluded from this response that Mr Zulu's learners had started asking questions in class. He also appreciated the learners' responses to his new classroom practice, "Ah... they are 100% Ja, ... the feedback is good. Ja". It appeared that the learners' response to his classroom practice was an indication that they enjoyed science. This was confirmed by the responses, "Ja they enjoy it a lot. Ja, they enjoy it I do know whether I am excelling I don't know" and also when explaining, "Maybe I am teaching of something that I had to add my extra knowledge based on that thing which does not cover the level of the grade." Mr Zulu confirmed in this response that his learners enjoyed science class.

6.5.1.6 Professional Identity

As mentioned in Section 6.3.1.6, professional identity as a theme comprises teacher confidence, beliefs, attitudes, and collaboration categories. Teacher confidence was noticed and coded in several of the responses in Mr Zulu's interview transcript, indicating that he was confident in different ways as a science teacher. His confidence was observed in the same way that he responded to the various interview questions. He was asked whether he had sufficient subject knowledge to teach NS. He displayed a lot of confidence in responding "Yes, yes, yes, I do have ma'am". Also, when asked to give an example of subject knowledge that was interesting or that he struggled to teach in the syllabus, he displayed confidence in saying, "There is no problem as far as everything is concern in science." This was also interpreted as Mr Zulu being confident in the NS subject knowledge acquired. Moreover, he said "I can answer any question in as far as science is concern". Mr Zulu's confidence was also observed in his response to the question of whether he thought his classroom practice had changed, saying "Ja, drastically". Moreover, he displayed a lot of confidence as he responded to the question on learner behaviour, again he repeated "yes" three times and also said "definitely" as he was asked in which way the learners' behaviour in class had changed after completing the ACE programme. Mr Zulu responded to the question of whether he had more confidence in teaching science by saying “More confidence, ja. I have confidence. I can answer anything as far as science is concern”. He even indicated that he assisted with science in the school. Mr Zulu’s responses demonstrated that his confidence as a science teacher could be attributed to the ACE programme.

Teacher’s belief was coded in several instances in Mr Zulu’s interview transcripts. This is interpreted as the influence of the ACE programme on his beliefs as a science teacher to a certain extent. Mr Zulu believed that the ACE programme had influenced him to be a better science teacher, saying “…now I am well equipped...” He believed that the learners’ responses were good feedback on his improved classroom practice. His belief was that his classroom practice had “drastically” changed. He clearly changed his beliefs regarding the value of practical work, saying: “Ja, it does change on my side because I have learnt a lot about the practical part of science. I was not a fan for before I attended ACE everything was practical than theory”. It can be concluded from this response that the ACE programme had improved Mr Zulu’s belief regarding the value of practical work.

Questions were asked to explore if the ACE programme had changed Mr Zulu’s attitude as a science teacher. He displayed a positive attitude, saying “Ja they enjoy it a lot. Ja, they enjoy it I do know whether I am excelling, I don’t know”. His attitude indicated that the learners had started to enjoy science because he excelled as a science teacher. He also displayed a positive attitude in saying that he enjoyed the ACE programme, “Ja, Eish, more than enjoying I don’t know how to put it”. It seemed that he lacked the appropriate words to express his enjoyment of the ACE programme. He further indicated that he enjoyed all the core knowledge, “...I enjoy them all”. Phrases like, “I can answer anything as far as science is concern” also indicated that the ACE programme had made an impact on Mr Zulu’s attitude and confidence regarding the teaching and learning of science. He also displayed a positive attitude to teaching when indicating that he needed apparatus to enhance his classroom practice as a science teacher.

Collaboration as a category was noted only once in Mr Zulu’s interview transcript. It was observed that this was not spontaneous, because he only responded when he was asked to. This was noticed when he was required to share what he had learnt in the ACE programme in the cluster. He responded with pride, saying: “You know I was elected to conduct the CAPS training because I was training the teachers as far as science is concern. Even here in the school I am assisting as far as science is concern". It can be concluded from his response that he had confidence in himself and that he assisted other teachers, as indicated in his response, but at the same time, he did not display strong beliefs regarding the value of collaboration. Mr Zulu's responses to the different interview questions indicated a growth in professional identity, in particular, regarding his confidence, beliefs and attitudes towards teaching science.

6.5.1.7 Programme outcomes

As already indicated, all the responses related to the envisaged and attained outcomes of the ACE programme were categorised under the theme programme outcomes. Mr Zulu was asked to indicate how he benefitted from the ACE programme. He was asked what he thought the DoE wanted him to learn from the ACE programme. He indicated that, "they want me to be.., hence I'm saying I must be more practical." He then continued to talk about the challenges of resources that the school did not have. This was already discussed under Section 6.5.1.3, since it addressed laboratory work rather than programme outcomes. Apart from doing more practical work, Mr Zulu did not share more on what he thought the DoE wanted him to learn from the ACE programme. His response indicated that he was overwhelmed by the lack of resources and other challenges that the school experienced.

Similarly, when responding to the question on what the Service Provider wanted him to learn, he said: "You know when we were trained in ACE course they-they trained us more practical things, that we must apply practicality since science is more practical but it difficult for us to do that with these challenges I have just mentioned. We have overcrowding, lack of resources like apparatus, laboratories and all those things". He did not mention specific knowledge and skills that the Service Provider wanted him to learn, except that they wanted him to be more practical. As Mr Zulu responded to the question, it again emerged that he was distracted by the lack of resources to conduct experiments in class.

Mr Zulu was asked how he thought his classroom practice was expected to change after completing the ACE programme, he replied: "Ja, it does change on my side because I have learnt a lot about the practical part of science. I was not a fan for before I attended ACE everything was practical than theory". It was noticed from his response that he learnt a lot about the "practical part of science". It is concluded that before completing the ACE programme, he did not have a passion for conducting practical work, as he used the phrase "I was not a fan." He was asked to expand on what he was taught in the ACE programme and practiced in his classroom, he responded, "Ja, like doing experiments." It was observed that he was frustrated by being unable to conduct the practical work due to a lack of resources. The situation at the school prevented him from implementing what he was taught in the ACE programme. Apart from learning the value of practical work, Mr Zulu had also gained practical skills, content knowledge, confidence and willingness to assist other science teachers in the school.

6.5.1.8 Summary of the interview

Mr Zulu responded to all the interview questions. Like the other teachers in the study, he did not answer some of the questions adequately, yet, the responses to such questions were important data that were used in the study. Such data was coded appropriately and discussed under the relevant themes.

During the interview, he often referred to the lack of resources at the school. He was also overwhelmed by the lack of resources to conduct experiments with the learners. This emerged during the interview when he referred to the lack of resources when he was asked to comment on his subject knowledge.

Mr Zulu believed that the ACE programme had influenced his classroom practice "drastically", as he put it. He displayed good classroom practice; this was observed in his response that he prepared lessons using textbooks and the internet, and that he could answer any question from the learners. He grouped the learners when they struggled to understand what he taught them. As already mentioned, he believed that the ACE programme had equipped him because he was able to answer any question in science. He also believed that he was "excelling". His pedagogical skills and subject knowledge had been enhanced. He was of the opinion that the learners' outcomes had improved after he completed the ACE programme. He claimed that his learners' feedback was positive and that they enjoyed his teaching.

Mr Zulu's professional identity seemed to have been impacted by the ACE programme. He was confident in teaching science, and his view was that he had become better teacher who was willing to share in the cluster meetings. He indicated that he was elected to conduct CAPS training where he trained other teachers, and also assisted other teachers at his school. His attitude towards teaching science seemed to be positive. This became evident when he was observed attending his classroom even when sick. Consequently, he was a resource person in the cluster and in the school.

Mr Zulu explained his own perception of change in his classroom practice, but he understood little about what the DoE and the Service Provider wanted him to learn from the ACE programme. He did not adequately mention the envisaged outcomes of the ACE programme, but gave his understanding of the expected outcomes. Overall, Mr Zulu believed that the DoE and the Service Provider wanted him to become “more practical” but he often indicated that this was a challenge due to the lack of a laboratory and equipment.

6.5.2 Lesson observations

Mr Zulu presented six lessons for observation. His NS lessons were spread in the school’s timetable, and some were before and others were after break.

Table 6.3 Summary of the findings of Mr Zulu's lessons

Lesson no.	**Topic**	**Duration of the lesson**	**Findings**	
			Learners' actions	**Teacher's actions**
1	Volcanic eruptions	1 hour	✓ In groups they made a mixture of vinegar and bicarbonate of soda with food colourant ✓ Demonstrated in front of the whole class erupting volcano ✓ Applauded the group that presented bt clapping their hands.	✓ Assessed learners as they were demonstrating erupting volcano
2	Consolidation of lesson 1	1 hour	✓ Listening ✓ Copied the picture of a volcano on their workbooks ✓ Labeled the picture of the volcano	✓ Gave learners feedback and explained why other groups could not get the vinegar and bicarbonate of soda to react ✓ Drew a picture of a volcano on the boards for learners to label
3	Compass	1 hour	✓ Answered questions orally ✓ Copied the picture of the compass on their	✓ Asked learners questions related to compass orally ✓ Drawing the picture of a compass on the

Lesson no.	**Topic**	**Duration of the lesson**	**Findings**	
			Learners' actions	**Teacher's actions**
			workbook to label	board for learners to label
4	Repeated the lesson on a compass	1 hour	✓ Answered questions in the workbooks	✓ Gave learners questions on the compass to answer as classwork
5	Corrections on lesson 4	1 hour	✓ Answered the classwork corrections as the teacher required ✓ One learner at the time came to the chalkboard to write the correct answers	✓ Facilitated the writing of corrections of the classwork given in lesson 4 on the chalkboard ✓ Instructed learners to copy in their workbooks the corrections
6	Mixtures	1 hour	✓ Responded to questions orally as the teacher was asking them ✓ Learners worked in groups and made mixtures	✓ Introduced the lesson through question and answer session ✓ Explained terms related to mixtures and solutions ✓ Wrote on the chalkboard the explanations ✓ Supervised learners as they were working in groups ✓ Summarized the lesson and gave them homework to do at home

6.5.2.1 Narratives of the lessons observed

Mr Zulu's first lesson was a demonstration of volcanic eruptions by learners. The learners were instructed in the previous lesson to make a model of a mountain using material like clay or paper Mache. Figure 6.13 depicts the different models of mountains that the learners made. Learners made the models in groups.

Figure 6.13: Models of mountains made by learners in preparations for the first lesson.

These models of mountains were used in the first lesson that was observed to demonstrate how a volcano erupts. Learners were also requested to bring household substances, namely vinegar, food colourant and bicarbonate of soda. The learners worked in groups on this activity and they presented in groups. As each group presented their model of an erupting volcano, Mr Zulu assessed them using the rubric prepared. When one group conducted their demonstration, the other groups observed and applauded when the reaction of vinegar and bicarbonate of soda occurred, demonstrating the erupting volcano. Groups' demonstrations were conducted until the last group had presented, which concluded Mr Zulu's first lesson.

The second lesson was a consolidation of the first lesson. Mr Zulu began the lesson by giving learners the feedback on their demonstration activity. The groups who were unable to make their model volcano erupt in the first lesson were advised accordingly during the feedback session. Mr Zulu indicated that some groups did not add a sufficient amount of bicarbonate of soda and therefore the reaction was not spectacular. He then read from the scores recorded in the rubric the result for each group, after which he drew on the chalkboard a picture of the erupted volcano, which the learners were required to label. The lesson was concluded by Mr

Zulu redrawing the sketch of a volcano on the board for learners to copy into their workbooks. Learners were then required to label the sketch.

Lesson three was on compass directions, and was introduced by oral questions where learners were required to give their understanding of a compass and cardinal points. A learner who gave a correct answer was appreciated applauded by the whole class. As a class, the learners were requested to point in the eastward, westward, southward and northward directions. Some learners in the class struggled to point in the correct direction, so Mr Zulu instructed one learner to go outside so that he could use him to demonstrate an eastward direction. This lesson was concluded by the teacher drawing a picture of a compass on the chalkboard, of which learners were expected to label the cardinal points. Mr Zulu taught the same lesson on the compass in the fourth lesson observed, however, this time, he gave learners class work to do where learners were expected to answer questions on what a compass is, and were required to name the uses of a compass.

Mr Zulu's fifth lesson focused on the corrections of the class work given in the fourth lesson. Lessons three, four and five were based on the content "the compass". When the fifth lesson started, he admitted to his learners that he was still sick. The corrections for the classwork given in the previous lesson were written on the chalkboard for the learners to write in their workbooks. Mr Zulu called a learner to come and write the answers on the chalkboard, if an incorrect answer was written, he corrected it for learners to write in their workbooks. The lesson was concluded with learners completing the writing of corrections into their workbooks.

Mr Zulu's sixth lesson was on mixtures. The lesson began by asking learners to give their understanding of the word mixture. Learners gave their understanding and finally the teacher consolidated the learners' answers, he then wrote the explanation of a mixture on the chalkboard. In his explanation of mixtures, he further differentiated mixtures from pure substances. In addition, he explained the definition of a solution, a solute and a solvent. Learners were previously requested to bring various household substances from home that could be used to make mixtures. They brought salt, sugar, rice, mealie-meal, samp and beans. See Figure 6.14 for an example of what the learners brought from home.

Figure 6.14: Examples of resources the learners brought from home.

Learners were required to work in groups for this activity. They were required to make different mixtures. As the learners engaged in hands-on activities, Mr Zulu moved from group to group checking on the mixtures they made, as well as ensuring that the groups were focused on the given task. All of the groups were engaged in the task, as required. The lesson was concluded by Mr Zulu explaining that some mixtures could be separated while others could not. Furthermore, he discussed with the learners the different types of methods of separating mixtures as the lesson was concluded. He then gave learners homework where they were expected to draw models of mixtures and pure substances, as well as to differentiate between mixtures and pure substances from the given pictures.

6.5.2.2 Analysis according to the observation schedule

Similarly to the other cases in this study, the data collected from lesson observations was analysed in terms of the observation schedule's main elements. These elements were subject knowledge, practical competence in conducting experiments, pedagogical skills, languages skills, and lastly, beliefs about and attitudes towards teaching science.

Subject knowledge

Mr Zulu did not explain much in the lessons that he presented. It was only in the third and sixth lessons where he explained some content in detail. In the second lesson, Mr Zulu explained briefly the different parts of the volcano. He also labelled the sketch of a volcano drawn on the board as he gave a brief explanation. Mr Zulu presented and explained the content in detail only in the third and sixth lessons.

It was noted that the learners in Mr Zulu's class did not ask questions related to the content. However, Mr Zulu asked them questions, for example, in the lesson on the compass, he started by establishing the learners' understanding of cardinal points before the new content was presented. He established the learners' understanding through a question and answer strategy. The learners responded to the questions asked.

Practical competence in conducting experiments

Mr Zulu's practical competence in conducting investigations was observed in the two lessons where hands-on practical activities were conducted by the learners. The resources used in the two lessons were pre-arranged. In the first lesson where the learners demonstrated the model of an erupting volcano, the learners had made the model of a mountain the previous day and brought the ingredients from home to demonstrate the erupting volcano. In the sixth lesson, learners brought ingredients from home to prepare mixtures. The majority of the learners brought similar ingredients, e.g. sugar, salt, samp, and rice, while others brought dry beans and juice.

The content on which the practical activities were based was found to be suitable for the Senior Phase. The content on volcanos was indicated in the Grade 7 departmental work schedules that the district provided to the school, and the RNCS document (DoE, 2002). Similarly to the content on mixtures, it was reflected both in Chapter 5 of the natural sciences statement, as well as in the departmental work schedule. All in all, the content used in the practical activities was suitable for Senior Phase learners.

In the two lessons where the learners were engaged in a hands-on practical activity, Mr Zulu did not write the aims of the practical activity on the chalkboard. However, the learners knew what was expected from them. In the first lesson, they were aware that they needed to demonstrate an erupting volcano. In the sixth lesson, the learners received clarification that they should make the mixtures of their choice and later try to separate these using any suitable method.

Learners performed hands-on practical work in the first and the sixth lessons. As already indicated, the apparatus used in the two practical lessons were brought by learners from home and therefore Mr Zulu did not prepare the apparatus himself, but he did organise that learners should bring this apparatus from home. In the first lesson, the learners prepared the model of a mountain the day before at home, where after the erupting volcano was demonstrated in class. In the sixth lesson, the learners brought all of the ingredients required to make their mixtures. Mr Zulu did not prepare worksheets for these lessons, but assessed the practical work of the first lesson using a rubric. The sixth lesson was not assessed, except in allowing learners to answer questions about the content on mixtures. This was done by drawing the sketches on the chalkboard representing pure substances and mixtures. Learners were required to study the sketches on the board, then indicate which were pure substances and which were mixtures. They were required to write their responses in their workbooks.

Mr Zulu conducted a practical demonstration in one of the lessons. In the third lesson on the compass, he conducted a practical demonstration where he explained to the learners the concept of the eastward direction. He demonstrated the eastward direction requiring one learner to go and stand outside so that other learners could observe his shadow. Unfortunately, not all of the learners could see the shadow through the window. This suggested that Mr Zulu needed to enhance his practical competence even further. The learners were expected to be able to tell the eastward direction from this demonstration. Mr Zulu did not formally assess the practical demonstration that he conducted for the learners.

Pedagogical skills

Mr Zulu demonstrated a range of pedagogical skills during the lesson presentations. The following skills were observed: continuous assessment, classroom management, constructivist approach, interaction with learners, learner participation, cooperative learning, and accommodating learners' different learning styles. Two skills were not observed during these lessons, namely, addressing misconceptions, and using discrepant events to further clarify concepts for the learners.

In the first lesson, he used a rubric to assess the learners when they demonstrated the erupting volcano. In the second lesson, the learners were assessed on their ability to label the sketch of the volcano correctly. In the third and fourth lessons, Mr Zulu assessed the learners' understanding of the compass and its cardinal points. In addition, in these two lessons, the learners were assessed as to whether they understood where east, west, south and north were. In the fifth lesson, there was not much of a continuous assessment, but in the sixth lesson, the learners were assessed orally and in writing regarding the mixtures and terms associated with mixtures.

Mr Zulu managed the classroom well in all six of the lessons he presented. The first lesson was an outdoor lesson where learners demonstrated the erupting volcano. The learners had the potential to be disruptive, but this did not happen as they behaved and followed the instructions throughout the lesson. He managed time effectively because the learners knew they had a limited time to demonstrate their erupting volcano. Each group presented as required. In all of the other lessons, the fact that they listened as the teacher facilitated demonstrated that the learners were cooperative. The sixth lesson was a practical lesson and yet the learners were well behaved and it was clear that Mr Zulu was in control. The learners knew when and what to write on the worksheet and in their workbooks. The oral questions were handled appropriately, and learners did not shout out simultaneously when responding, but rather talked one by one when given the opportunity by Mr Zulu.

Mr Zulu utilised a constructivist approach, to a limited extent. Attempts were made by Mr Zulu to relate what he taught to real life examples. This, however, did not happen much. In the sixth lesson, Mr Zulu related the whole lesson to a real life example by requiring learners to bring ingredients to make mixtures from home. It was not observed in any lesson that Mr Zulu linked the content taught to the learners' prior knowledge. Mr Zulu did corrections of the previous lessons, or simply started with the new lesson, for example, as it has happened in the sixth lesson where he did not link the lesson on mixtures to what the learners already knew about mixtures.

There was a good interaction between the learners and Mr Zulu. In the first lesson, as the learners presented their demonstrations, they cooperated with him when he requested them to keep quiet when it was one of the other groups' turn to present. In the second lesson, Mr Zulu interacted well with the learners, requiring them to label the sketch of a volcano. When the learners made the mixtures in the sixth lesson, Mr Zulu moved from group to group supervising. During the supervision, good interaction was observed where Mr Zulu asked the learners questions to ascertain whether the mixtures made would be separable.

Learners were actively involved in all of the lessons that Mr Zulu presented. However, the level of participation differed from lesson to lesson. In the first lesson, for example, learners actively participated by conducting the demonstration of an erupting volcano. The whole class actively participated because each member of the group wanted to present a model of an erupting volcano. In the second lesson, the learners were actively involved in answering the oral questions asked by the teacher. In the third lesson, the learners listened to the teacher and one learner was used to demonstrate a direction on the compass. In the fourth lesson, which was a repeat of the third lesson, learners answered questions orally, and in the fifth lesson, they contributed by writing corrections on the board. In the sixth lesson, the learners actively participated by making mixtures in groups.

Cooperative learning was only observed in the first and the sixth lessons. In the first lesson, learners worked cooperatively sharing ideas on the amount of vinegar and bicarbonate of soda to mix in modelling an erupting volcano. In the second, third, fourth and fifth lessons there was no cooperative learning observed. It was then observed again in the sixth lesson where learners made mixtures in groups. They cooperated and learnt from one another about the substances to mix in order to get a separable mixture.

Ideally, the use of visuals and models in all science lessons are ideal for enhancing learning. What was noticed in three of Mr Zulu's lesson presentations was that he used models and visuals well. In the first lesson, the whole lesson revolved around the model of a volcano. As indicated earlier in this lesson, learners were required to model the erupting volcano. In the third lesson one learner was used to demonstrate a compass direction. In the second, fourth and fifth lesson, the use of models or visuals to enhance learning was not observed. In the sixth lesson, the ingredients brought by learners from home to make the mixtures were viewed as visuals used to explain the scientific concept of mixtures better.

Mr Zulu did not plan each lesson to accommodate the different learning styles of the learners. It appeared that the different lessons only favoured the learning styles of a particular group of learners. The first and the sixth lessons accommodated learners with kinaesthetic preferences, who learn best when conducting presentations and conducting hands-on practical activities. The first and the third lessons involved demonstrations, which accommodated visual learners who learn best by observing or watching certain phenomena. In the second and the fifth lessons, corrections were done and the teacher wrote on the board while learners listened as well as in the fourth lesson, where the third lesson on “the compass” was repeated, which accommodated learners who are auditory and learn best by listening.

Learners were asked only lower order questions in Mr Zulu’s classroom. In the first lesson, no questions were asked by the teacher, he simply called one group after the other to come and demonstrate. In the second lesson, only lower order questions were asked: What do you think are the benefits of volcanic eruptions? In the third lesson, the questions asked were: What is a compass? Name four cardinal points, point eastwards, northwards, westwards, and southwards.

Similar questions were asked in the fourth lesson: What is a compass? What are the uses of the compass? In the sixth lesson, the questions asked were: What is a mixture? What is the difference between a mixture and a pure substance? What is a solution? What is a solvent? What is a solute? No attempts were made to ask questions of different cognitive levels, all of the questions asked were lower order questions.

Mr Zulu made little use of direct teaching. In the second lesson, he provided feedback on the first lesson by allowing learners to label the picture of the erupted volcano. In the third and fourth lessons, the teacher used only direct teaching and discussions where oral questions were posed to learners. Mr Zulu demonstrated his pedagogical skill in the lessons that were observed, particularly his knowledge of learners and his ability to keep them interested in a science lesson. He did this by using demonstrations, as in the third lesson, and allowing them to conduct activities in groups, as was the case in the sixth lesson.

Language skills development

It was observed during the lesson observations that Mr Zulu was concerned about developing the language skills of the learners. In the first lesson, the learners presented their demonstration in English, which was the LoLT of the school. The learners spontaneously responded in English. Mr Zulu was observed in the third lesson assisting learners to pronounce the word ‘compass’ correctly. He required the learners to repeat it twice after him, which was probably done to enhance the reading skills of the learners. In the sixth lesson, learners were requested to read the terminology that the teacher had written on the board. The terminology was ‘pure substance’, ‘mixture’, ‘solute’, ‘solvent’ and ‘solution’. As they read, Mr Zulu requested them to pause so that he could explain the terminology.

Mr Zulu code-switched appropriately in some of the lessons presented. In the first and second lessons, he did not code-switch, and communication was in English. In the third lesson, he code-switched in referring to the cardinal points in isiZulu. He was also observed code-switching frequently as he moved from group to group during the sixth lesson, while suggesting to learners what ingredients to mix.

Beliefs and attitudes

Mr Zulu displayed a high level of confidence in most of the lessons presented, except in the fourth and the fifth lessons where he was sick. Although he had fever on these days, he managed to keep the learners busy for the duration of the lesson. In the first lesson, he displayed confidence in assessing the learners' demonstration of an erupting volcano and scoring them. In the second lesson, he was confident in assisting the learners to label the sketch of an erupted volcano. In the fourth lesson, he challenged learners to ask questions, but they did not use the opportunity. In the fifth lesson, as indicated, Mr Zulu was sick and thus did not talk much in the classroom. In the sixth lesson, Mr Zulu displayed confidence as he moved from desk to desk, guiding learners as they made making mixtures.

Confidence was also observed in the second lesson where he made a sketch of a volcano on the chalkboard to be labelled by the learners. In the third lesson, Mr Zulu showed confidence in presenting content on the compass and cardinal points. In the sixth lesson, Mr Zulu asked learners if their mixtures were easily separable. He displayed confidence in moving from group to group. Mr Zulu displayed enthusiasm as a science teacher. This was observed in the first lesson as he assessed and scored the learners' demonstrations. In the fourth and fifth lessons, no enthusiasm was observed, but this was ascribed to him being sick.

Mr Zulu motivated the learners when teaching science. He was observed in the first lesson challenging one group who failed to get their vinegar to react with the bicarbonate of soda to assess what their challenge was and how it could be overcome. In the second, third and sixth lessons, learners were asked oral questions to encourage them to understand the concepts being taught. In the fifth and fourth lessons, the teacher was sick and rather soft spoken. Although he was sick, Mr Zulu attended his classes, which depicted him as a committed science teacher with a good attitude towards teaching. He preferred to repeat the lesson rather than leave the learners unattended. It seems that he did not want to reduce their tuition time by absenting himself due to ill health. Clearly, Mr Zulu showed a positive attitude towards teaching.

6.5.3 Document analysis

A document analysis was conducted to strengthen the data collected from the interview. The presentation and discussion of the document analysis is according to the elements of the document analysis guide. These elements were: activities based on practical work; the frequency of the written work; activities that required higher order thinking, and evidence of different assessment activities given to learners. The analysis of the learners' workbooks is presented first, followed by Mr Zulu's documents and records.

6.5.3.1 Learners' workbooks

Three learners' workbooks were requested and analysed after each lesson observation. These workbooks were selected by Mr Zulu in his classroom.

Activities based on practical work

The analysis of the learners' books revealed that the learners were given written work based on practical work, however, these were few. There were three such activities found in the learners' workbooks. Two of the three were written during the lesson observations. Similar to the other cases, the increased effort to conduct practical work during the lesson observation period indicates the Hawthorne effect as explained by Leonard and Masatu (2006). It was believed that teachers would continue with the practice after lesson observation.

The three activities concerned plate movements, which were demonstrated using two sheets of paper, modelling volcanic eruptions and the separation of mixtures. One example of such an activity is shown below in Figure 6.15.

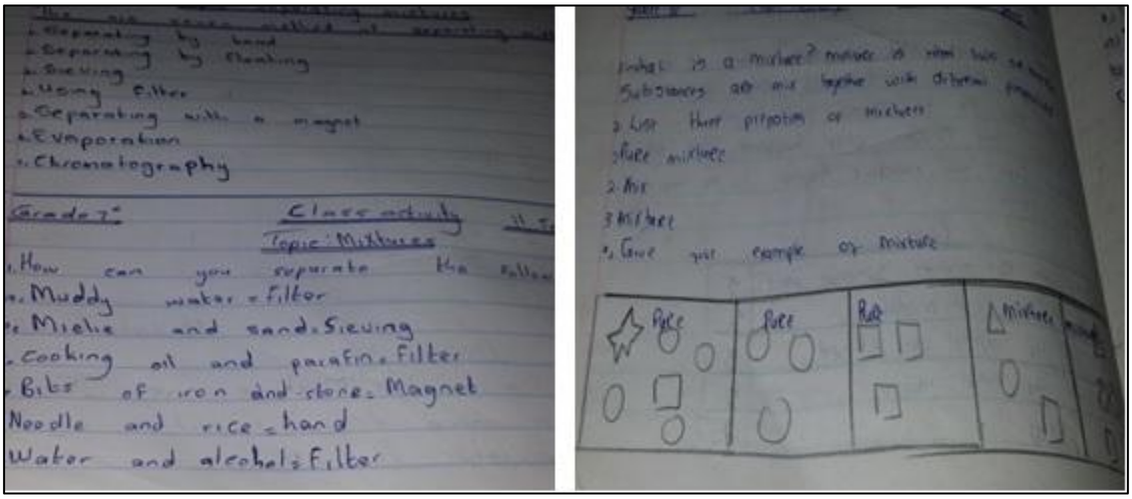


Figure 6.15: Activity based on practical work from the learners' workbooks

The frequency of written work

It was found in the learners' workbooks that in January alone, there were 11 written tasks, in February, there were six written tasks, one in March, 11 in April, 12 in May, one in June, five in July, and four in August. There was a total of 52 written tasks, but only four were based on practical work. As indicated, it was noted that out of the four, two were written during the lesson observations. There was evidence that the learners were given written tasks for the content taught in each month.

Accuracy of the feedback given to the learners by the teacher

The analysis of the learners' workbooks revealed that after each and every written task, learners were given feedback. Mr Zulu checked and signed the written tasks and gave feedback to the learners. He signed their work as an indication that he had control checked the learners' workbooks. The corrections written in the learners' workbooks were appropriate.

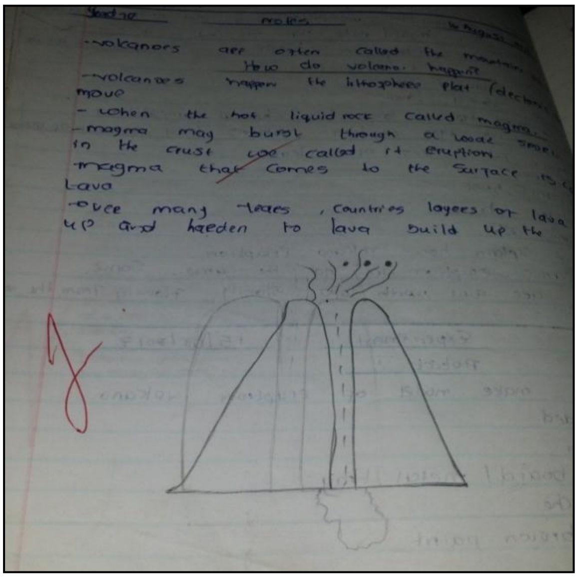
Activities that require higher order thinking

The learners' workbooks mainly reflected recall kinds of activities, although there were a few questions that required learners to describe and change information from one form to another. Such questions, for example, were: draw and label the structure of a plant as well as explain how the earthquake happens. Other examples of the activities that required higher order thinking are shown in Figure 6.15, where learners where required to explain how different kinds of mixtures can be separated. However learners in their responses only named the methods of separating mixtures instead of explaining.

Evidence of the different types of assessment activities given to learners

The analysis of the learners' workbooks revealed that they were given different assessment activities. The different types of assessment activities ranged from assignment, investigation, projects, translation tasks, and tests. In some of these different assessment activities, the learners were formally assessed. In the translation tasks, it was found that they were required to draw a picture of an erupted volcano, how the movement of plates occur, and models of mixtures and pure substances. One such example is depicted in figure 6.16.

6.16a



6.16b

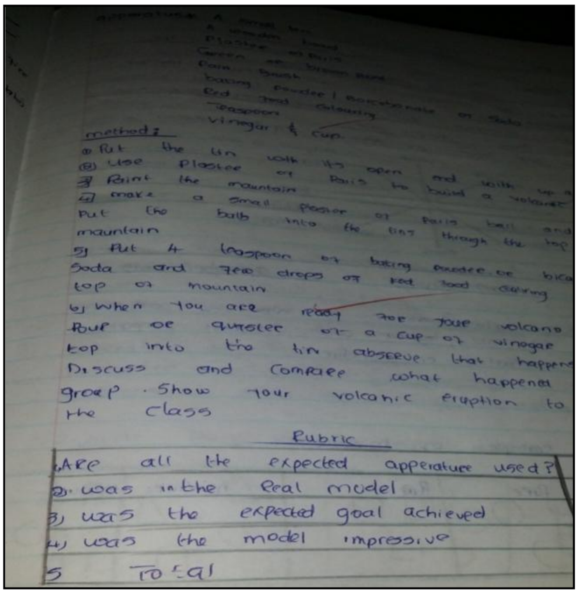


Figure 6.16: Examples of different forms of assessments given to learners

In figure 6.16a, the learners were required to explain how volcanic eruptions happen, and in figure 6.16b, they were given a procedure to follow when conducting a demonstration of a volcanic eruption. The teacher provided the learners with a rubric that he was going to use to assess the demonstration well in advance.

6.5.3.2 Analysis of the teacher's documents and records

The teacher's documents analysed included the lesson preparations, work schedule, programme of assessment and records of learner performance. The elements in the document analysis guide were used to analyse these. These elements were: the teacher planning that involves practical work, scientific content covered for the grade in planning, the learners' assessment records planned for various learning styles, and the recording sheets of the learners' performance. Mr Zulu's file was requested and analysed after each lesson observation.

Activities in teacher planning that involve practical work

The departmental work schedule provided by the district indicated a lot of content where practical work was to be conducted. This departmental work schedule was found in Mr Zulu's file. The programme of assessment prescribed different forms of assessment to be done per term, and an investigation that could be a practical task was one of these.

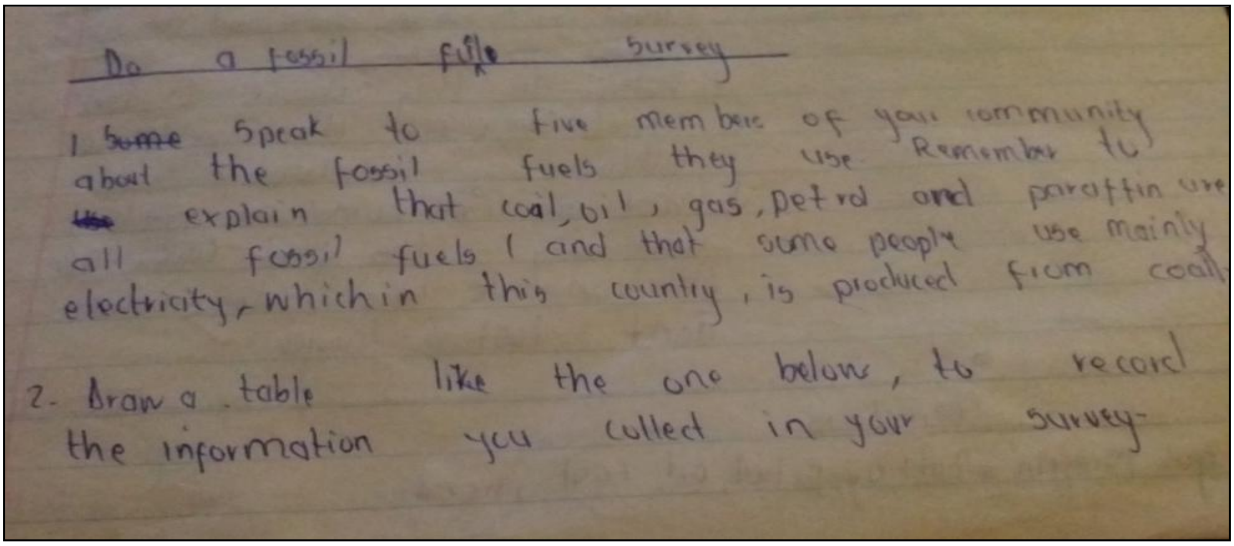
There was a worksheet on mixtures and the separation of mixtures, there was a handout in Mr Zulu's file guiding learners on recycling, and there was a worksheet on how to demonstrate plate movement using sheets of papers. Therefore, there were three activities in Mr Zulu's planning that involved practical work, which was less than required by the work schedule.

Scientific content covered for the grade in the planning

The content covered in the planning was found to be suitable for the grade, and was in agreement with the work schedule as distributed by the district. Mr Zulu was up to date according to the work schedule. He developed his lesson preparations from the departmental work schedule provided to the school, and there was evidence of planning in his file. The scientific content covered included the core knowledge and concepts of natural sciences, as prescribed by the department. These were life and living, planet Earth and beyond, energy and change, as well as Matter and Materials. The departmental work schedule was developed such that the Life and Living content area was covered in the first term; Planet Earth and Beyond in the second term; Matter and Materials in the third term, and Energy and Change was allocated to the fourth term.

Learners' assessment records planned for various learning styles

The learners' assessment records found in Mr Zulu's documents revealed the activities planned for various learning styles. There were activities in Mr Zulu's documents where learners were expected to read and write. Such activities were done by all of the learners, but this favours learners who read easily. There were other activities where learners were required to demonstrate and do presentations. These activities were meant to favour learners who are kinaesthetically orientated and learn best by doing. Learners' assessment records were reflected in an investigative activity, as shown in Figure 6.17.



Do a fossil file survey

1 ~~Some~~ Speak to five member of your community about the fossil fuels they use Remember to ~~use~~ explain that coal, oil, gas, petrol and paraffin are all fossil fuels (and that some people use mainly electricity, which in this country, is produced from coal)

2. Draw a table like the one below, to record the information you collect in your survey.

Figure 6.17: Example of an activity planned to accommodate learners of different learning styles

Recording sheets for learner performance

There were recording sheets for learner performance in Mr Zulu's file. The learners' marks were recorded for all of the formal tasks and converted to percentages. The informal tasks were not recorded in the recording sheets. It was found in the recording sheet that the learners' marks were well spread from 20% to 84%.

6.5.4 Summary of Mr Zulu's case

It was found during the interview with Mr Zulu that he believed that his subject knowledge had improved from the ACE programme. He believed that he had sufficient subject knowledge to teach NS in Grade 7. This was confirmed during the lesson observations where he presented and explained the scientific content correctly. The document analysis revealed that he gave learners correct feedback on the homework and classwork activities, indicating a sufficient command of subject knowledge. This result indicate that Mr Zulu's professional identity was enhanced and according to the theoretical framework of the current study the improved professional identity leads to enhanced classroom practice. This is illustrated by arrow 2 of Figure 3.3 (Clarke & Hollingsworth, 2002). As already indicated Mr Zulu explained the scientific content correctly, this is because he believed he had sufficient subject knowledge. Clearly, arrow 1 of Figure 3.3 is not applicable according to this result, there was no direct influence in the classroom from the professional development but it happened through the professional identity.

Mr Zulu had little opportunity to develop the practical skills that he had learnt in the ACE programme because there was no laboratory or scientific apparatus in his school. He explained that he had to improvise in order to do experiments. He was of the opinion that the lack of apparatus limited his chances of practicing what he had learnt in the ACE programme.

The lesson observations confirmed the data from the interviews because in the two hands-on activities conducted by the learners, it was observed that the resources used were brought by the learners from home. He improvised to be able to conduct some of the practical activities. Clearly, he must have had some degree of practical competence because he could improvise in these cases.

Mr Zulu indicarted during the interviews that he planned his lessons using textbooks and the internet before teaching. He also said that he used different teaching strategies. Furthermore, he indicated that he assessed learners continuously. The use of different teaching strategies was confirmed in the lesson observations where it was found that he taught by using demonstrations, presentations by learners, direct teaching, as well as allowing learners to work in groups. The document analysis attested to this because there were written assessment activities that had been given to the learners, even though the frequency differed from month to month. It was also found from the lesson observation that his classroom was well managed. Good management was noticed in a lesson such as the first one, where learners demonstrated an erupting volcano, or the last lesson where learners conducted a practical in the classroom. The lesson observations indicated that the learners interacted well with Mr Zulu. He supervised the groups when they were engaged in hands-on activities. Mr Zulu indicated during the interview that his learners had started asking questions to challenge him. However, this could not be confirmed as during lesson observations, the learners did not ask questions. It is possible that the presence of the researcher in the classroom influenced them. This result confirms that Mr Zulu has impacted the domain of consequence where learner outcomes were enhanced to a certain extent. This is in alignment with the theoretical framework where professional identity and the classroom practice are reflected in the learner outcomes. These are illustrated by arrow 5 and 6 of Figure 3.3 (Clarke & Hollingsworth, 2002). As already indicated learners interacted well with Mr Zulu.

Mr Zulu indicated during the interviews that he was excelling as science teacher after completing the ACE programme. He also expressed that he was confident in teaching science and also helped in training other teachers during the CAPS training sessions. So, arrow 9 of Figure 3.3 applied in Mr Zulu's case as he was contributing to the professional development of other teachers (Clarke & Hollingsworth, 2002). He displayed confidence in supervising the groups of learners during the lesson where learners made different mixtures. His confidence and belief in himself as a science teacher was confirmed during the lesson observations. He displayed a positive attitude towards the teaching of science because he honoured his lessons even when he was sick with influenza. Attending to the learners even when he was sick presented itself as a salient outcome which is as a result of his professional identity and classroom practice. As already indicated, according to the theoretical framework of the current study salient outcomes located in the domain of consequence are influenced by professional identity and classroom practice. This is illustrated by arrow 5 and arrow 6 of Figure 3.3 (Clarke & Hollingsworth, 2002).

One of the most valuable contributions that came from Mr Zulu confirmed that the ACE programme convinced him to do more practical work and experiments with his learners. He added that he assisted in CAPS training. There was synergy in the data collected through the interviews, lesson observations and document analysis in Mr Zulu's case, except in a few instances where there was no agreement, such as learners not asking questions, however, such disagreements were few.

6.6 MS NTOMBELA'S CASE

Ms Ntombela taught in a township school that accommodated learners from Grade R to 9. Learners remained in their classroom while the teachers changed classrooms in this school. This was the only case in this study where the teacher indicated that there was a laboratory with resources. Ms Ntombela was a post level one teacher with matriculation, SPTD and ACE natural sciences qualifications. She had five years of teaching experience in science.

6.6.1 Interview– presentation of data according to themes

6.6.1.1 Introduction

Ms Ntombela requested that she be interviewed in her classroom during break because she had no free periods on the day of the interview. The classroom was not conducive to the interview, but there was no alternative. This was the only opportunity and venue she available for the interview, which was scheduled for 45 minutes because break was 45 minutes long. Break lasted between 11h00 and 11h45. During the interview, Ms Ntombela was hesitant, giving short answers without elaborating. The researcher often needed to probe for more information. Ms Ntombela also did not respond fluently in English during the interview.

6.6.1.2 Subject knowledge

When Ms Ntombela was asked if she had sufficient subject knowledge to teach the syllabus in NS Grade 7, she responded immediately, saying “No”. The researcher then asked her why, and she added, “I have got all the information in order for the learner to understand much better”. This sounded like a contradiction, which may mean that she believed that she did not know the subject knowledge well, but that she had information sources that she could consult. Her answer created the impression that she lacked confidence.

Later, when asked if she thought her subject knowledge had improved, she responded positively saying “Yes”. A follow up question was asked for her to name one scientific concept that she thought she had learnt in the ACE programme, she responded “Like matter I understand more matter I did not understand before, but while I took i-ACE I understand more matter, most of the time”. Presumably, she had learnt subject knowledge under the knowledge strand of Matter and Materials from the ACE programme. She again referred to this topic mentioning, “Phases of matter like solid, liquid, gas” when asked to share something she had learnt from the ACE programme that she practiced in class.

6.6.1.3 Laboratory work

As indicated in Table 4.6, the theme of laboratory work comprises practical skills, resource needs and improvisation categories. When Ms Ntombela was asked if she had sufficient practical skills to do the prescribed experiments, she again responded by saying “No”. A follow up question was asked for her to explain further, but she did not elaborate, instead she indicated that she regarded practical work as important to improving the learners’ understanding. Ms Ntombela indicated that she regularly did practical work, saying “per week it depend, it depend on the content”, suggesting that the time to conduct experiments relied on the kind of content taught in a particular week.

Later, when required to mention a specific thing that she enjoyed in teaching science, she again referred to practical work: "Like ah! Doing practical, we experience daily life at home and even at school. Learners will come and Ma'am what happens their fathers, their mothers know but there is something only to find that their mothers are not well educated. There is something like their forefathers know". Ms Ntombela clearly enjoyed teaching science using practical activities and relating these to daily life. Although she was concerned that the learners' mothers were not educated, she believed that their forefathers had some knowledge related to the practical part of science. The interview also revealed that Ms Ntombela had enough resources to conduct experiments. In fact, the school had a laboratory. Hence, she did not need to improvise much for teaching and learning as there was a laboratory with apparatus in the school. Nevertheless, she sometimes use improvised materials to do investigations, saying "Yes, that's why I sometimes, they bring at home". She did not specify the kinds of resource the learners would bring from home, but one could conclude that the learners brought consumables, seeing that the school had a laboratory with apparatus.

6.6.1.4 Pedagogical knowledge

As shown in Table 4.6, the theme of pedagogical content knowledge comprised two categories, namely, pedagogical skills, and understanding how learners learn science. Prior to the interview, Ms Ntombela was observed planning a lesson and organising her file. When asked which information sources she used to plan and prepare for each lesson, she replied, "I took from the NCS, NCS is a guideline. It guides you where must I start where must I end up. Especially from the column of teacher's activities, learners' activities". It appeared that the information source Ms Ntombela used was the National Curriculum Statement (NCS). She did not mention textbooks, or any other resources like the internet, or the work schedule, as anticipated.

Ms Ntombela's pedagogical skills were observed when responding to different interview questions, for example, she said "I move from the simplest to the complex"; "I use various method" and "You can change the method". She was aware that teaching is more effective when learners are taught by starting with simple concepts, progressing to complex ones. To assist learners of different learning styles, she indicated that using different teaching methods could assist, explaining: "Like I say before, I use various methods". For those who struggled to understand what they were taught, she repeated, "I use the various methods of teaching I move from the simplest to the complex ...You can see like teaching grade 7 A, B, C. On A learners may understand more. You can change the method". All in all, the key strategy that she mentioned was varying teaching methods. However, she did not give a specific example to illustrate what she was saying.

Another pedagogical skill learnt during the programme was revealed when Ms Ntombela claimed that one thing she enjoyed about the ACE programme was hypothesising. In her own words, she said: "Like ah question of hypothesis. Most of the question what if the rain, like the cloud solids the question what if? What if? Even if learners don't see the rain but they understand easier". She also learnt to use the learners' contexts because she indicated that learners sometimes brought apparatus from home.

Ms Ntombela was asked to explain the kinds of experiences she thought would enable learners to learn science, she responded, "I use science equipment, science equipment". It seemed that she was emphasising the use of equipment, as she repeated it twice. She also communicated this understanding while referring to a lack of equipment, explaining "Some of the learners learn better... so if they can see something, it is much more understanding" She also indicated that she used visual aids, such as " Ama... ama ama like ama-resources like ama-posters charts" to support learning.

In short, she demonstrated the understanding that engaging with equipment, different teaching methods, moving from the simple to complex, and hypothesizing enhances the teaching and learning of science.

6.6.1.5 Learner outcomes

Learner outcomes refer to learner performance, attitudes and behaviour. Ms Ntombela was asked if learners' behaviour in class changed after completing the ACE programme, to which she responded, "Yes they change but more in teaching". From this response, it was not clear how the learners' behaviour during lessons had changed compared to before she had completed the ACE programme.

Ms Ntombela was asked to respond whether she thought that learners had begun to enjoy science. Her response indicated that the learners enjoyed it when she was "active". Seemingly, the "active" from her response related to when she conducted demonstration activities. In her own words, she said "While I am active, they enjoy much." Ms Ntombela was also asked if she struggled with learners who did not complete homework and submitted assignments late. She responded, saying, “No most of them are not struggling but some little learners, I think it depends from their parents, it depending on their parents are not educated they come late”. Ms Ntombela’s response indicated that most of the learners were cooperative, as she struggled with “little learners”. She also indicated that it depended on their parents. Some of the learners’ parents were not educated, and those learners came late to school. It can be concluded that Ms Ntombela was still struggling with some learners who did not behave as expected, despite her having completed the ACE programme.

6.6.1.6 Professional Identity

Teacher confidence, beliefs, attitudes and collaboration categories, as indicated in Table 4.6, were grouped under the theme of professional identity. At the beginning of the interview, Ms Ntombela did not show confidence in her own content knowledge and laboratory skills. However, she later became more relaxed and actually displayed some confidence, although she remained modest. When asked if she had more confidence in teaching science after completing ACE, she indicated that she had gained confidence from sharing ideas with others during the cluster meetings: “Ja, by sharing the ideas information like kuma-cluster meeting we share information”. Furthermore, she indicated with confidence that she enjoyed teaching “much more” than before she had completed the ACE programme. Ms Ntombela was specifically asked if she was willing to share in a cluster meeting what was learnt in the ACE programme. Again, confidence was noticed in her response, “Yes-ja, yes”, confirming that she was willing to share in the cluster.

Ms Ntombela believed that she had become a better science teacher with improved subject knowledge. She indicated that she consulted information sources to teach science, and later in the interview, she indicated that her subject knowledge had improved and mentioned “matter” as a topic that she understood better. Belief in her own judgement was also observed when she indicated that experiments would be conducted depending on the content she had to teach in a particular week. She also held the belief that planning should be informed by the NCS document “NCS is a guideline. It guides me where must I start where must I end up.” Furthermore, she displayed a belief in the value of using scientific equipment for learners to learn science. In addition, she displayed a strong belief that using different teaching methods enhances learning. Finally, she indicated a strong belief that science is valuable, saying “Everything that we do is science”. This indicates a belief that science is not limited to the classroom.

The category of teacher's attitude appeared in several instances in Ms Ntombela's interview transcript. She displayed a positive attitude towards doing practical work when she indicated that her school had enough apparatus to conduct experiments. It was also observed as she indicated that learners sometimes brought apparatus from home, and that she regularly did practical work, as required by the curriculum. She also displayed a positive attitude towards the ACE programme, indicating that she enjoyed it. When asked if she had anything else that she wanted to share, she responded "Yes, ma'am I like science because it explain daily life." These responses indicated Ms Ntombela's positive attitude towards science as a subject.

Collaboration was only coded in two instances in Ms Ntombela's interview transcript. This was observed when Ms Ntombela was asked if she had more confidence in teaching science, to which she replied "Ja, by sharing the ideas information like kuma-cluster meeting, we share information". The sharing of information indicated that she was willing to work with other teachers. Also, when asked if she was willing to share what was learnt in ACE in the cluster meeting, she responded positively. It was concluded from these responses that she was willing to collaborate with other teachers.

6.6.1.7 Programme outcomes

All responses related to the envisaged and attained outcomes of the ACE programme were categorised under the theme of programme outcomes. Ms Ntombela was asked what she thought the DoE wanted her to learn from the ACE programme, to which she responded that it was to develop her teaching skills. In addition, when asked what she thought the Service Provider wanted her to learn, she responded, "To develop the skills of learning and teaching for my kids". It was concluded from these responses that her understanding was that both the DoE and the Service Provider wanted to enhance her skills of learning and teaching.

When asked how she thought her classroom practice was expected to change, she responded saying "Yes eh…50% change by doing the various methods to teach I learn from ACE". It seems that she was not expecting to change in totality after completing the ACE programme. Her answer also indicated that she had learnt various teaching methods from the ACE programme. She indicated that she regarded herself as a better teacher, referring to brainstorming and the value of using various teaching methods.

Ms Ntombela also indicated that her content knowledge improved, saying "I understand more matter when I took i-ACE." She also indicated that she enjoyed teaching science, and indicated that she had learnt how to use hypothesising in the classroom. This response indicates that Ms Ntombela had learnt the "phases of matter" from the ACE programme and that she used it in class. She indicated that "Learners do not understand evaporation, solids". Clearly, her learning the "phases of matter" from the ACE programme have been helpful for her in explaining it to learners because, according to Ms Ntombela, the learners usually foud that content difficult. Furthermore, Ms Ntombela indicated that some learners' behaviour had change after completing the ACE programme, except a few who came late to school. She claimed, as indicated earlier, that this was due to their parents not being educated.

6.6.1.8 Summary of the interview

Although Ms Ntombela responded to all of the questions asked during the interview, her responses did not always revealing the information that was sought, as observed in the other case studies. In addition, she struggled to respond fluently in English, but it was possible to mostly understand what she wanted to say. Despite being hesitant, she indicated that she had gained subject knowledge to teach the syllabus in NS, but she acknowledged that some learners still did not understand some concepts, like evaporation. Ms Ntombela indicated that she had sufficient apparatus to conduct experiments, but also that she improvised whenever necessary. This was the only case in the current study where a teacher acknowledged having enough apparatus to conduct experiments with learners. In the other three case studies, there were the challenges in terms of a lack of apparatus and a lack of a science laboratory. She indicated that she used the NCS as a guide to plan lessons, but did not specify clearly how she selected learning activities to use when teaching science. She viewed the use of various teaching methods as important to accommodating learners who struggled to understand what she taught, as well as those with different learning styles. It was observed that Ms Ntombela believed that she should use science equipment for learners to learn science.

Also, Ms Ntombela believed that she had learnt from the ACE programme. Her attitude, as noted from her responses to the interview questions, was that she enjoyed teaching science more as compared to before she had completed the ACE programme. While she viewed her classroom practice and professional identity as being better, learner outcomes were still not as anticipated. This was evident in that she mentioned that she was still struggling with learners who came late to school, and learners who still did not understand some of the content, like evaporation. She also said that some learners did not do their homework. However, this does not imply that the ACE programme did not assist her in enhancing her classroom practice. Ms

Ntombela believed that she was a better teacher in terms of subject knowledge after completing the ACE programme. She was confident in sharing what she had learnt from the ACE programme in the cluster. Her understanding was that the DoE and the Service Provider wanted to enhance her teaching skills through the ACE programme.

6.6.2 Lesson observations

Ms Ntombela planned that she would present six lessons for the observation. However, one of the lessons was used to finalise the administrative task that was due to be submitted the following day.

Table 6.4 Summary of the findings of Ms Ntombela's lessons

Lesson no.	**Topic**	**Duration of the lesson**	**Findings**	
			Learners' actions	**Teacher's actions**
1	The changing earth's surface	1 hour	✓ Read notes simultaneously about the changing earth's surface from their textbook ✓ Listened to the explanation attentively ✓ Wrote the activity in their workbooks	✓ Explain what the learners where reading in English as well as in isiZulu ✓ Explain the picture of the changing earth's surface ✓ Reprimanded learners who were looking around whiles the lesson was in progress ✓ Instructed learners to write in their workbook the activity from the textbook
2	The result of plate movements	1 hour	✓ One learner was requested to write on the board the corrections of the previous lesson. ✓ Copied the corrections in their workbooks ✓ Read the topic of the new lesson then notes on plates movement from their textbooks	✓ Confirmed the answers by referring in the textbook before allowing learners to copy in their workbooks ✓ Reprimanded learners for looking around while the lesson was in progress ✓ Gave learners an activity from the textbook to do

Lesson no.	**Topic**	**Duration of the lesson**	**Findings**	
			Learners' actions	**Teacher's actions**
3	District assessment	1 hour	✓ Engaged in practical activity for grade 6	✓ Gave learners grade 6 activity to do as she wanted to focus on district assessment
4	Corrections based on lesson 2	1 hour	✓ Gave answers to the homework as teacher required ✓ Wrote answers on their workbooks	✓ Wrote answers on the chalkboard as the learners were giving her ✓ Confirmed the correctness of the answers ✓ Instructed learners to copy corrections in their workbooks
5	The compass	1 hour	✓ Attempted to explain the word "compass" as the question was posed ✓ Listened attentively as the teacher explained from her notes	✓ Explained the word "compass" to the learners ✓ Read the notes on the compass from her file
6	Pure substances and mixtures	1 hour	✓ Responded to questions orally ✓ Read the notes in the textbook as the teacher explained ✓ Wrote classwork based on pure substances and mixtures	✓ Introduced the lesson through question and answer session ✓ Explained the picture showing the model of different kinds of substances ✓ Gave learners a classroom to complete in class

6.6.2.1 Narratives of the lessons observed

Ms Ntombela's first lesson topic was the "changing of the earth's surface". She used a textbook method as her teaching method. All of the learners were required to open their textbooks where there was an activity on the changing of the earth's surface. Learners were required to read the notes preceding the activity. As learners read along simultaneously, Ms Ntombela requested them to pause so that she could explain some of the content that they were reading. The explanation was both in the school's LoLT and isiZulu. There were pictures of a changing earth in the textbook, which were explained by the teacher step by step for learners to understand. The activity in the textbook had five questions that were explained in detail for the learners. The learners listened attentively, nodding to confirm that they were following and understanding. They also confirmed by loudly saying 'YES' repeatedly. Ms Ntombela spent about ten minutes reprimanding the learners for looking around while she was teaching. As teaching continued, oral questions were asked to assess the learners' understanding. This lesson was concluded by allowing the learners to write the individual activity in their workbooks. This activity was from the textbook that each learner had.

The second lesson was on the result of plate movements. Firstly, the teacher verified who had not attended her previous lesson. Thereafter, one learner was required to write on the chalk board, giving the feedback of the previous lesson's activity. The rest of the learners gave answers with the help of Ms Ntombela, who confirmed their answers by referring to the textbook. As in the first lesson, Ms Ntombela spent about ten minutes reprimanding the learners for looking around while she was teaching. She then observed and checked that the correct answers had been written. The learners were given the opportunity to write the corrections in their workbooks, after which the teacher started with the new topic for the day. Direct instruction was also used in the second lesson. The learners were required to read the topic, and thereafter continue to read the all of the notes on plates' movement from the textbook. As they were reading, Ms Ntombela requested them to pause so that she could explain some of the content they were reading. She code-switched, explaining both in the LoLT and in isiZulu. There was a diagram on plates' movement alongside the notes, which she gradually explained, which the learners affirmed by shouting 'YES'. Ms Ntombela assessed the understanding of the learners by asking them oral questions based on the content. The lesson was concluded and learners were expected to write the individual activity on their workbooks as homework. The individual activity was taken from the textbook that each learner had.

The third lesson focused on the district assessment, as it was time for the teacher to submit the assessment records; the record of the district assessment was required the following day. Seeing that the learners could not be left unattended, Ms Ntombela gave them a Grade 6 practical activity to do on their own. Each group was given bulbs, connecting wires and cells. They were required to get the bulb glowing using the resources provided. This activity was not assessed; but was merely given to keep the learners busy while she finalised the district assessment records of the learners. The lesson was concluded by the ringing of the bell, signalling the end of the period.

The fourth lesson focused on the feedback regarding the lesson on plates' movement conducted in the second lesson. The feedback on the activity that was given to the learners as homework was given. She required learners to give answers with her help, and as correct answers were given, Ms Ntombela wrote those answers on the chalk board. Through this approach, the whole activity's feedback was written on the board. Thereafter, learners were given an opportunity to write the corrections in their workbooks. This concluded the fourth lesson of Ms Ntombela.

The fifth lesson dealt with the compass, and the teacher started the lesson by giving learners instructions to take out their textbooks. Learners were required to explain their understanding of the word "compass". Different learners gave their understanding, which the teacher consolidated by telling learners that "the compass was an instrument used to find direction". The learners' textbooks did not include any information on this topic, which was in contrast with the first and second lessons. The teacher prepared notes on the compass from her reference textbook and wrote these on the chalkboard for learners to copy into their workbooks. Thereafter, Ms Ntombela read the notes and explained these to the learners. Although the explanation was mainly in English, she also used isiZulu. As the lesson was concluded, learners were given a compass per desk to see and to discover for themselves the North Pole. The teacher wrote the cardinal points on the chalkboard and the lesson was concluded by asking learners recall kinds of questions on the uses of the compass.

The sixth lesson concerned the identification of pure substances and mixtures. This content could also be found in the learners' textbooks. The lesson was started with oral questions on mixtures. The learners were then required to read the notes in their textbooks as she explained, when necessary. In this lesson, she also code-switched as she explained. Ms Ntombela subsequently drew the attention of learners to the picture depicting a model of pure substances and mixtures in the textbook. The picture of the model is depicted below in Figure 6.18. The learners were required to identify pure substances and mixtures from the models. The learners' attention was drawn to the activity in the textbook, from where Figure 6.18 was extracted. The teacher explained the activity in detail, then the learners answered some of the questions orally. Ms Ntombela then requested them to write the activity as classwork. The lesson was concluded as the learners completed this classwork.

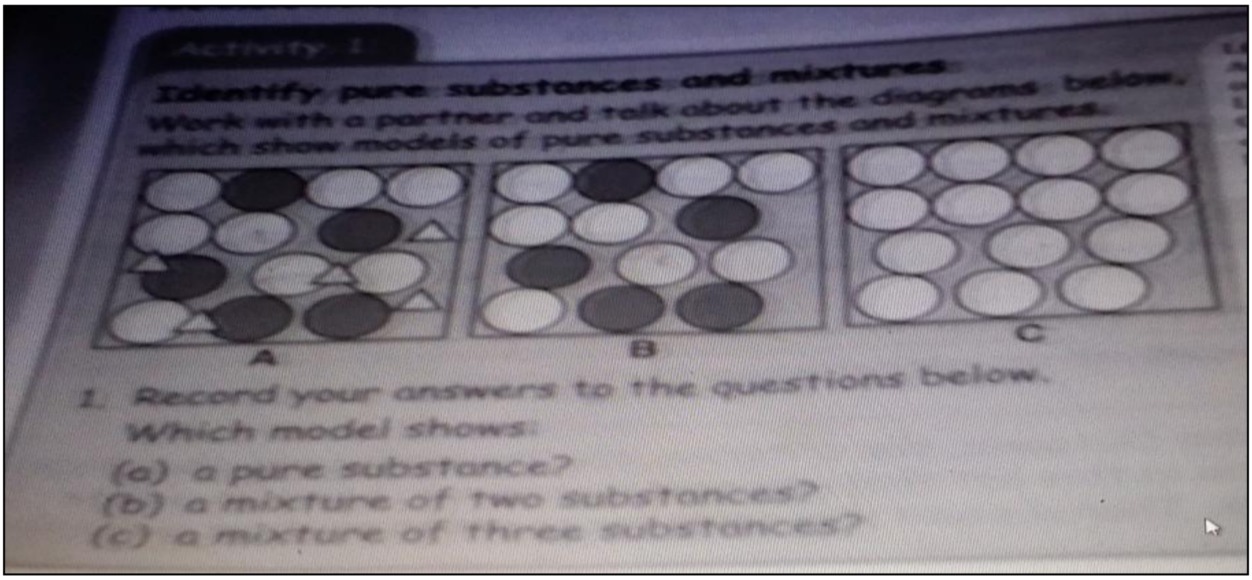


Figure 6.18: Model of pure substances and mixtures extracted from the textbook.

6.6.2.2 Analysis according to the observation schedule

The data collected from the lesson observations was analysed in terms of the observation schedule's main elements. These elements are: subject knowledge, practical competence in conducting experiments, pedagogical skills, language skills, and lastly, beliefs about and attitudes towards teaching science.

Subject knowledge

Ms Ntombela's lesson presentation was seen as satisfactory because she taught science using the textbook or notes prepared. On the whole, Ms Ntombela presented the content correctly, indicating adequate subject knowledge.

In the lessons where the content was presented, Ms Ntombela required the learners to read from their textbooks or notes. As reading progressed, she stopped the learners and explained some content. The explanations revealed that Ms Ntombela had sufficient subject knowledge to teach NS in Grade 7. The learners did not ask questions in any of the lessons observed. However, whenever Ms Ntombela asked them questions, they responded, for example, in the fourth lesson, the learners did not ask questions, but the teacher required that they answer questions from the activity in the textbook.

Practical competence in conducting experiments

All of the lessons that Ms Ntombela presented were such that direct teaching was used. There was no provision made for learners to perform experiments or hands-on activities. There was no experiment conducted by the learners, except in the lesson where she intentionally kept the learners busy while she had to complete an administrative task. This was supposed to be the third lesson, however, Ms Ntombela focused on the district assessment records as she explained that it was due to be submitted the following day. In this lesson, the learners were kept busy with a hands-on activity on electricity. The content of the activity was suitable for Grade 6 learners. The other lesson observed where learners were partly engaged in a hands-on activity was the fifth lesson. In this lesson, the learners were taught about a compass, and compasses were distributed to the learners. One compass was provided per desk while the lesson was already in progress. The learners in this lesson were required to find the North Pole of the compass. Although this was a simple task, it indicated that she was prepared to make use of apparatus. However, by giving learners circuit equipment and a practical task to keep them busy, this did indicate that she was familiar with the use of equipment during lessons. All in all, Ms Ntombela did not display much practical competence in conducting experiments in the lessons presented, but she did show that she was familiar with some of the equipment.

Pedagogical skills

Ms Ntombela demonstrated a range of pedagogical skills when teaching. These are discussed below according to the criteria in the observation schedule. The following skills were observed: continuous assessment, classroom management, constructivist principles, interaction with learners, learner participation, and accommodating different learning styles, to a limited extent. During these lessons, three skills were not observed: using cooperative learning, addressing misconceptions, using discrepant events to further clarify concepts for learners, and asking learners questions that required higher order thinking.

Ms Ntombela employed continuous assessment in the different lessons. In the first and second lessons, she used oral questions to assess the learners' understanding as each lesson progressed. In the fifth lesson, the learners were asked recall kinds of questions to assess their understanding of what was taught. In the sixth lesson, there was continuous assessment where learners were asked questions in the beginning of the lesson and at the end of the lesson. They were given classwork taken from the textbook that was meant to assess what was taught. The class work was based on pure substances and mixtures, and the actual questions are depicted in Figure 6.18.

Ms Ntombela managed the classroom such that she wanted learners to be quiet, they were not allowed to talk to one another and no movement was allowed throughout the lesson. In the first and the second lessons, Ms Ntombela was observed spending about ten minutes reprimanding the learners for looking around while she was teaching. Clearly, her teaching time was not well managed. However, she knew when to allow learners to read from the textbook, when to stop explaining from the textbook, and when to start giving learners classwork to do. The oral questions were well managed because the learners gave responses only when required to do so.

Ms Ntombela seldom utilised constructivist principles. In the second lesson, Ms Ntombela requested one learner to come and write corrections on the board while the rest of the learners provided answers, with her help. The start of the new lesson with corrections from the previous lesson was an indication that the learners could link the new knowledge with that of the previous lesson. In the fifth lesson on the compass where she related the use of the compass in real life, she gave an example by mentioning that in the olden days it was used in aeroplanes and ships for direction. She never linked new knowledge to learners' contexts throughout the six lessons.

There was interaction between the learners and Ms Ntombela. She interacted well with the learners but disciplined them harshly when they talked to one another in class. In the first and second lessons, she posed questions to which the learners responded, as she expected. In the third lesson, there was no interaction observed and in the fourth lesson, learners interacted by contributing in giving responses for corrections. In the sixth lesson, Ms Ntombela interacted with the learners well in giving responses.

The learners actively participated in most of her lessons. In the first and second lessons, they were involved through answering the questions and through reading from the textbook, as per the instruction of the teacher. In the fourth lesson, they responded to questions, and in the fifth lesson, they held the compass trying to find the North Pole, as required. In the sixth lesson, the learners responded to questions.

Ms Ntombela mostly did not use models and visual examples to explain scientific concepts. In the first and second lessons, she requested learners to read from the textbook where there were diagrams used to explain these concepts. In the third and fourth lessons, the use of models and visuals was not observed. In the fifth lesson, the compass was used as the only visual, with learners excitedly holding the compass and trying to find the North Pole. There were visuals used in the sixth lesson, which were in the form of pictures modelling pure substances and mixtures. These were found in the learners' textbook.

Ms Ntombela accommodated the various learning styles of the learners in some of the lessons she presented. In the first, second and the sixth lessons, a direct instruction from the textbook was used. Learners who learnt best by reading and writing were accommodated by these lessons. The reading of the second lesson had diagrams, and the sixth lesson reflected pictures with models of pure substances and mixtures. Therefore, the diagrams and pictures with models accommodated learners that are visually orientated. In the fifth lesson, she referred to her notes, thus learners who are auditory were accommodated by this lesson. Ms Ntombela used different teaching strategies, but it was observed that reading from the textbook was the dominant strategy. Oral questioning was used as a different teaching strategy. In the first, second and the sixth lessons, she used a textbook method for teaching and integrated this method with oral questioning. In the fifth lesson, she again read from the notes, but also integrated this with oral questioning. Teaching strategies like group work and cooperative learning were not employed.

Direct teaching was the main teaching strategy used in all of the lessons that she presented. Learner involvement was limited to reading together from the textbook. As the reading of content progressed, Ms Ntombela would interject and explain the notes, dominating the lessons.

Language skills development

Ms Ntombela's approach to teaching, as already indicated, was mainly in requiring learners to read aloud from the textbook. This approach is assumed to enhance learners' reading skills. As already indicated, the learners were provided with the opportunity to read in the first, second and the sixth lesson. The opportunity to write was also provided to learners, because after Ms Ntombela explained the notes, she requested them to write either classwork or homework in their workbooks. This was observed in the first, second, fifth and sixth lessons. In the rest of the lessons presented, learning activities that accommodated language skills were not observed.

Ms Ntombela code-switched when explaining to learners. In the lessons where reading occurred, she constantly interrupted their reading, her explanations were mostly in isiZulu. This was observed in the first, second, fifth and the sixth lessons. In the third and the fourth lessons, where there was no actual teaching, code-switching was also observed. As Ms Ntombela provided the learners corrections, she explained both in the LoLT and in isiZulu.

Beliefs and attitudes

Ms Ntombela displayed some confidence in teaching science in reading from the textbook or from her prepared notes. In the first lesson, before beginning with the lesson, she referred to her preparation for the day, after which she requested the learners to start reading from the textbook. This presumably enhanced her confidence. This was also observed in the second and the sixth lessons. Ms Ntombela displayed enthusiasm in teaching science, which was observed in the first lesson through the sixth lesson that she taught. As she explained from the textbook for the first, second and sixth lessons, she did so enthusiastically. In the lesson where she gave learners feedback, such as the fourth lesson, Ms Ntombela displayed enthusiasm in the teaching of science. Ms Ntombela attempted to inspire learners, although she mainly used oral questioning. Her attitude was that learners should be inspired to learn science when participating in the lesson through answering questions. As indicated in Section 6.6.2.2, the learners in Ms Ntombela's class did not ask questions, instead, she asked them questions. Oral questioning encouraged the learners to listen attentively when the teacher explained so that they could respond correctly. This was observed in the first, second, fifth and the sixth lesson. In the third lesson, where they were given an opportunity to build circuits, they were inspired and excited. In the fourth lesson, they were inspired to participate by giving answers while corrections to the previous activity were discussed.

6.6.3 Document analysis

A document analysis was conducted to strengthen the data collected from the interview and lesson observations. The presentation and discussion of the document analysis is according to the elements of the document analysis guide. The analysis of the learners' workbook is presented first, followed by Ms Ntombela's documents and records.

6.6.3.1 Learners' workbooks

After lesson observations, three learners' workbooks were requested for the purpose of document analysis. Ms Ntombela collected these from the classroom, and they were then analysed after each lesson observation. The elements indicated in the document analysis guide were used for the analysis. The elements were: activities based on practical work; the frequency of written work; accuracy of feedback given to learners by the teacher; activities that required higher order thinking, and evidence of different assessment activities given to learners.

Activities based on practical work

It was found from the analysis of the learners' workbooks that there was only one activity based on practical work by August, which was a practical on modelling the structure of the earth using an egg. This activity was conducted earlier in the year, prior to the lesson presentations. It was found that activities that were based on practical work were scarce in the learners' workbooks.

Frequency of written work

There were six written tasks reflected in the learners' book for January, five in February, two in March, eight in April, thirteen in May, nothing in June, three in July, and four in August. The total written work found in the learners' workbooks by the end of August was 41. Only one of the 41 was based on practical work.

Accuracy of feedback given to learners by the teacher

The analysis of the learners' workbooks revealed that learners were given feedback inconsistently. The corrections were done on some of the homework and classwork, but not in all. Figure 6.19 depicts how some of the corrections were done by learners in Ms Ntombela's class.

She monitored that the learners did the corrections, although a few managed to get away with not doing them. Ms Ntombela's approach in giving learners feedback was asking questions, and as learners responded correctly, she then wrote the answers on the board for them to copy into their workbooks.

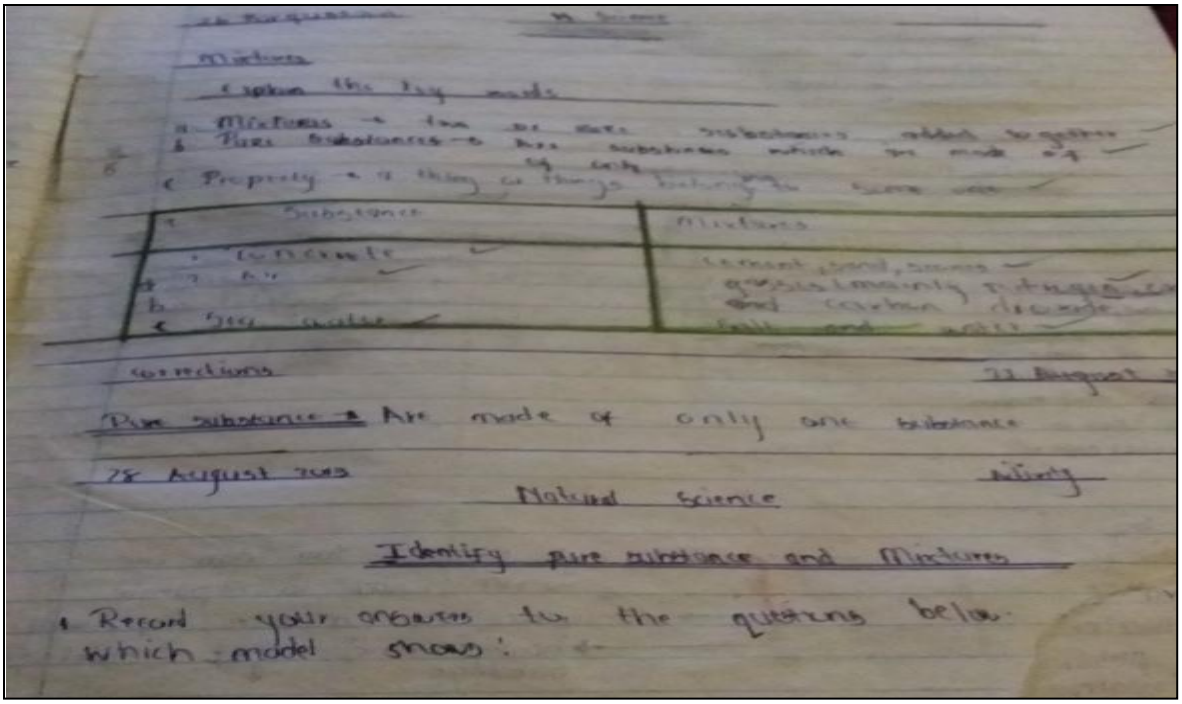


Figure 6.19: Example of corrections by Ms Ntombela's learners.

Activities that require higher order thinking

There was evidence of activities that required higher order thinking found in the learners' workbooks, but it was found that most of the activities mainly focused on the recall of information. In one activity, the learners were required to explain how plate movement happens. Such questions required higher order thinking because learners were required to analyse, synthesise and evaluate knowledge learnt before answering the question. In another assignment, learners were required to describe how a volcano erupts. Such activities were found both in formative and summative assessments, such as a test given to the learners, however, there were few of these.

Evidence of different types of assessment activities given to learners

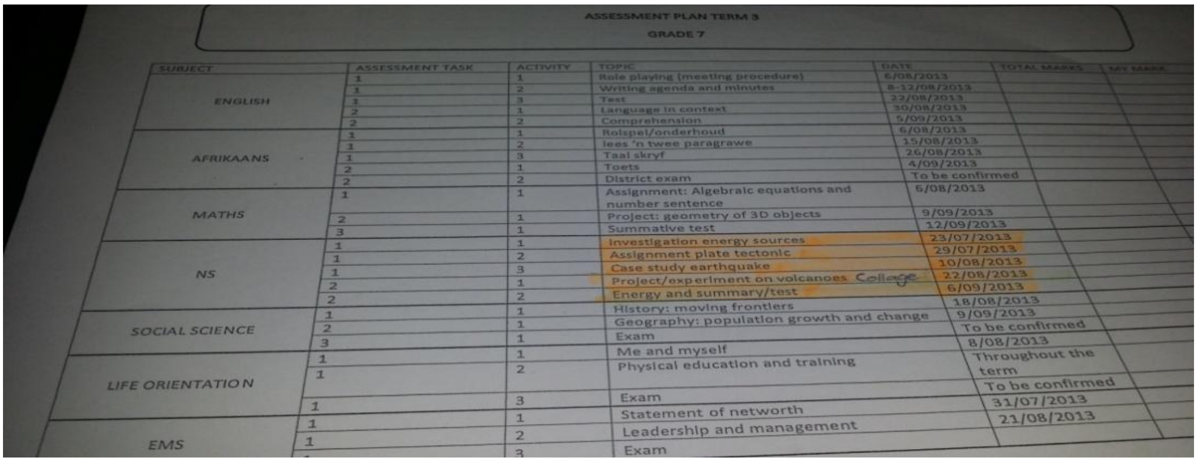
There was evidence of different types of assessment from the learners' workbooks, for example, the learners were given translation activities where they were expected to change information from one form to another. There was a homework activity given to the learners where a pie chart was to be changed into a table. There were other different types of activities where learners were expected to draw the planets given the sizes and diameters. It was found that projects, translation tasks and investigations were given to learners as formal assessments. Ms Ntombela tried to expose learners to the different forms of assessment for NS, probably because these were contained in the programme of assessment.

6.6.3.2 Analysis of the teacher's documents and records

The teacher's documents that were analysed included the lesson preparations, work schedule and programme of assessment, while her records included the lists of marks indicating learner performance. All of these documents were found in Ms Ntombela's file. The file was made available to the researcher after each and every lesson observed. The teacher's documents and records were analysed in terms of the elements guiding the document analysis. As indicated in Section 6.2, these elements were: teacher planning that involves practical work, science content covered for the grade in planning, learners' assessment records planned for various learning styles, and recording sheets for learner performance.

Activities in teacher planning that involve practical work

The work schedule provided by the DoE included in Ms Ntombela's files reflected content where practical tasks were recommended. The preparations of these lessons indicated that Ms Ntombela planned to conduct practical demonstrations and experiments with the learners. It was indicated that learners would conduct a practical task on pure substances and mixtures. It was also seen in the teacher planning that the learners were to conduct a practical task where they were required to make a model of an erupted volcano. The programme of assessment indicated that the school had planned for practical investigation, namely, "investigating energy sources", which was to be assessed formally, as seen in Figure 6.20. Figure 6.20 depicts a summary of the programme of assessment for all of the Learning Areas, of which natural sciences is highlighted in an orange colour.



ASSESSMENT PLAN TERM 3

GRADE 7

SUBJECT	ASSESSMENT TASK	ACTIVITY	TOPIC	DATE	TOTAL MARKS	MY MARK
ENGLISH	1	1	Role playing (meeting procedure)	6/08/2013		
	1	2	Writing agenda and minutes	8-12/08/2013		
	1	3	Test	22/08/2013		
	2	1	Language in context	30/08/2013		
	2	2	Comprehension	5/09/2013		
AFRIKAANS	1	1	Rolspel/onderhoud	6/08/2013		
	1	2	lees 'n twee paragrawe	15/08/2013		
	1	3	Taal skryf	26/08/2013		
	2	1	Toets	4/09/2013		
	2	2	District exam	To be confirmed		
MATHS	1	1	Assignment: Algebraic equations and number sentence	6/08/2013		
	2	1	Project: geometry of 3D objects	9/09/2013		
	3	1	Summative test	12/09/2013		
NS	1	1	Investigation energy sources	23/07/2013		
	1	2	Assignment plate tectonic	29/07/2013		
	1	3	Case study earthquake	10/08/2013		
	2	1	Project/experiment on volcanoes Collage	22/08/2013		
	2	2	Energy and summary/test	6/09/2013		
SOCIAL SCIENCE	1	1	History: moving frontiers	18/08/2013		
	2	1	Geography: population growth and change	9/09/2013		
	3	1	Exam	To be confirmed		
LIFE ORIENTATION	1	1	Me and myself	8/08/2013		
	1	2	Physical education and training	Throughout the term		
	1	3	Exam	To be confirmed		
EMS	1	1	Statement of networth	31/07/2013		
	1	2	Leadership and management	21/08/2013		
		3	Exam			

Figure 6.20: The programme of assessment from Ms Ntombela's file

Science content covered for the grade in the planning

Ms Ntombela's lesson preparations reflected the science content covered for Grade 7, as prescribed in the departmental work schedule. This was observed in the work schedule that the district had distributed in all schools. The work schedule was present in Ms Ntombela's file, as well as the lesson preparations, which reflected the content in the departmental work schedule. She had planned to teach the content as prescribed in the work schedule, and this was concluded based on the lesson preparations found in her file. The scientific content covered included the strands of natural sciences. These were life and living, planet Earth and beyond, energy and change, as well as Matter and Materials. The departmental work schedule was developed such that the Life and Living content areas were covered in the first term; Planet Earth and Beyond in the second term; Matter and Materials in the third term, and Energy and Change was allocated to the fourth term. Ms Ntombela was clearly behind in the departmental work schedule because she was still on Planet Earth and Beyond, which was supposed to be completed in the second term.

Learners' assessment records planned for various learning styles

The assessment records in the teacher's file indicated that learners' assessments were mainly focused on the use of questions that recalled information. There were few activities with higher order questions found in the learners' workbooks. Some activities were based on a practical task. There was also evidence of assessments where learners had to study diagrams and then answer questions, as seen in Figure 6.21.

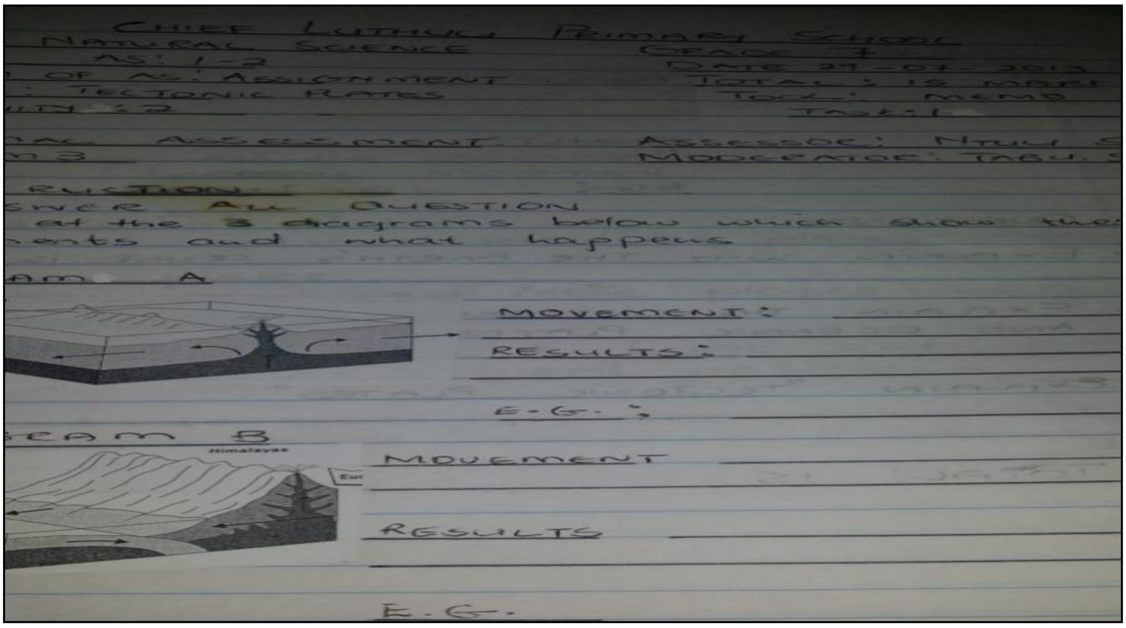


Figure 6.21: Example of assessment planned for learners

Learners were also given a test and assignments compiled by the district. In the district assessment, there were different question types, including questions based on the practical work or experiments conducted in class. Questions of the different cognitive levels found were: Why is the worst damage often done at the epicentre of an earthquake? Traditional houses in Japan were made from bamboo and rice paper. Why do you think fewer people died as a result of earthquake when houses were built of these materials? Ms Ntombela's planning provided evidence that she catered for the various learning styles of learners. Such planning was found in the assessment programme where learners, for example, were required to "investigate energy sources" and to "build a project of a volcano", then demonstrate volcanic eruptions.

Recording sheets for the learner performance

The learners' recording sheets found in the teachers' file indicated that the school based assessment (SBA) had already been conducted. The marks allocated to the learners for the four formal assessments done for term one and two were reflected in the mark list and converted to a percentage. There were marks and percentages recorded for previous assessment tasks before the data was collected. It was found that the performance of learners in the class was well spread out. The learners were performing at between 20% and 70%. The researcher also noted that the informal tasks were not recorded in the recording sheet.

6.6.4 Summary of Ms Ntombela's case

Ms Ntombela indicated during the interview that she had learnt subject knowledge from the ACE programme. In addition, it was noted that when responding to the question of subject knowledge, her answer created the impression that she was not confident in her subject knowledge. It was noted during the lesson observations that she was comfortable teaching from the textbook or from the notes, but not confident in teaching without referring to these. Clearly arrow 4 of Figure 3.3 was not so applicable in Ms Ntombela's case as she was not so confident to teach without a textbook. According to the theoretical framework for the current study a professional development is reflected in the personal domain (Clarke & Hollingsworth, 2002). So, visible impacts of the professional development were not noticed in Ms Ntombela's personal domain.

The data collected from the lesson observations were partly in agreement with the data collected from the interviews concerning the practical competence of Ms Ntombela. With regard to practical skills, Ms Ntombela indicated in the interviews that she did not have sufficient practical skills to conduct experiments with learners. In contrast, she also stated that she enjoyed teaching science using practical activities, and that her school had enough apparatus to do experiments. During the lesson observations, there were no experiments conducted. Instead, she mostly used direct teaching from the textbook and notes. There were no opportunities created for learners to conduct hands-on activities, except the unplanned activity where she allowed the learners to build circuits while she completed an administrative task. This event suggested that actually, she was familiar with the apparatus and sometimes included practical activities as part of teaching. Overall, the conflicting data makes it difficult to draw a conclusion about Ms Ntombela's practical competence.

During the interview, Ms Ntombela indicated that she used different teaching methods to accommodate learners with different learning styles. She also claimed to use visual aids like charts and posters to support learning. Furthermore, she indicated that she planned lessons to include different teaching methods. This data was partly confirmed during the lesson observations. In the different lessons she presented, it was found that she used direct teaching, oral questions and reading aloud by learners. Ms Ntombela was observed using visuals like diagrams and pictures only in the second and sixth lessons. The only equipment she used was to teach about the compass in the fifth lesson. However, the analysis of the learners' workbooks revealed that there were activities where drawings were made. This indicated that she indeed did use visuals to clarify scientific content in a few lessons presented for observation. Also, in Ms Ntombela's case a direct enhancement of the classroom practice from the professional development was not noticed. Clearly arrow 1 of Figure 3.3 was not visible. What she managed to do in the classroom was as a result of her professional identity and this is illustrated by arrow 2 of Figure 3.3 (Clarke & Hollingsworth, 2002).

Ms Ntombela was asked about the learner outcomes, and indicated that there were still learners who were not well behaved. Alternatively, she indicated during the interviews that the learners enjoyed learning when she was "active". Her belief that some learners were not well behaved was observed during the lesson presentation, where she spent approximately 10 minutes reprimanding those learners that she viewed as naughty. Apart from the learners who were not cooperating, the analysis of the learners' workbooks revealed that learners wrote homework and classwork as required. Overall, Ms Ntombela's case did no apparently align with the theoretical framework of the current study with regards to learner outcomes. Arrow 5 and 6 of Figure 3.3 did not happen because she believed learners were naughty. Her professional identity and classroom practice did not make much difference in the domain of consequence (Clarke & Hollingsworth, 2002).

Furthermore, the interview revealed that Ms Ntombela's professional identity had developed somewhat following the ACE programme, but that she still lacked confidence. Although she indicated that she had learnt content and enjoyed practical work, she did not show confidence in her subject knowledge nor in her practical skills. Her lack of confidence was confirmed during the lesson observations, where she was found to be teaching from the textbook or from notes; she did not have confidence to teach without a reference. However, her view was that the ACE programme had made her a better science teacher. The most remarkable opinion that Ms Ntombela revealed about how ACE had changed her classroom practice was teaching using various methods. As indicated earlier, she stated that the learners enjoyed it when she was "active", she also added that she learnt the "phases of matter" from the ACE programme.

6.7 CHAPTER SUMMARY

This chapter presented the analysis of data collected through the interviews, lesson observations, as well as data on the analysed documents related to the learners' workbooks and teachers' documents and records. The presentation of the data analysis was done per case study. Data from the interviews were presented using the predetermined themes, as well as themes that emerged as topics. The data from the lesson observations were presented using elements of the observation schedule as topics, and data from the document analysis was presented using the elements and criteria from the document analysis guide. For each case, the trustworthiness of the data was enhanced by information gained from the three data sources, although a few exceptions were found.

The results indicated that the four teachers who participated in this study were of the opinion that their subject knowledge had improved after completing the ACE programme. These results are in accordance with the theoretical framework for the study, that a professional development enhances the knowledge, beliefs and attitudes of teachers. This is illustrated by arrow 4 in Figure 3.3 linking the external domain and personal domain (Clarke & Hollingsworth, 2002). Arrow 1 was not noticed from the results of all the teachers because there was no idea learnt from ACE programme that was directly implemented in the classroom. However, three of the four teachers indicated that they needed resources to teach what they had learnt in the ACE programme. The four teachers who participated in the study shared a common view during the interviews about conducting practical work. They believed that learning in science is enhanced when doing practical work (Section 6.3.1.3; Section 6.4.1.3; Section 6.5.1.3; Section 6.6.1.3). All, except Ms Ntombela, were observed presenting some practical lessons. They also relied on improvisation as an option whenever there were no resources in the school. Three of the four teachers were observed improvising during practical lessons. It was found from the analysis of the learners' workbooks that in all four cases, learners had more written activities based on practical work over the period of the lesson observations as compared to the period from January to August. It could be interpreted that the teachers in this study did not consistently use practical work for teaching, suggesting that they presented their best efforts for the lesson observations. This could be due to the Hawthorne effect, where respondents change their behaviour once they become aware that they are under study (Leonard & Masatu, 2006). It could also mean the content area where teachers were comfortable conducting practical work coincided with the period of data collection.

The three data sources were mostly in agreement regarding the teachers' pedagogical knowledge. The participating teachers in this study believed in group work, oral questioning, and discussion as teaching strategies. However, Ms Ntombela was not observed using group work. Also, reading from the textbook or notes was found to be used by all of the teachers in the study, which could mean that they all believed that learners' reading skills could be enhanced by allowing them to read aloud in the science classroom. It could also be that they were drawing on their own experiences as learners from many years ago when they were required to read aloud from textbooks. Classroom management in terms of learning activities was found to be common in the four cases. In three of the four cases, where practical work was conducted, the few apparatus were well managed and prepared in advance. Learners were informed to bring resources from home a day before such resources would be used and this was seen as part of resource management.

Teachers in this study believed that the learner outcomes had improved in terms of behaviour, performance, and attitude related to submitting tasks and assignments. However, they all had found that not all of their learners had changed after they completed the ACE programme. All four teachers were of the opinion that they were still struggling with a few learners in terms of behaviour, performance and attitudes. This implies that although learner outcomes were reported to have improved after completing the ACE programme, there were still challenges with a few learners. The results regarding the improvement of learner outcomes are in accordance with the theoretical framework for the current study. The improved classroom practice as well as the enhanced professional identity of teachers is reflected in the learner outcomes located in the domain of practice. This is illustrated by the reflective arrows 5 and 6 in Figure 3.3 (Clarke and Hollingsworth, 2002). As already mentioned in Section 6.6.4 this was not noticed in the case of Ms Ntombela who believed her learners were naughty.

Teachers' views and what was learnt from lesson observations indicated that they all believed that the ACE programme has enhanced the development of their professional identity. Their view was that the ACE programme has assisted them in terms of specific content they mentioned and pedagogical skills like group work, hypothesising and teaching by doing practical work. All of the teachers said that they were confident and could assist other teachers in the cluster of schools, although the level of confidence differed from case to case. This is in accordance to the theoretical framework for the study that professional development lead to improved knowledge, beliefs and attitudes which is about the professional identity of teachers. Also, teachers of improved professional identity become resource persons in the external domain. This is illustrated by arrow 9 of Figure 3.3 that links the personal domain to the external domain (Clarke and Hollingsworth, 2002). Arrow 9 suggests that teachers of improved professional identity could contribute to the professional development of others and the results are aligned to this view.

Generally speaking, the views of the four teachers after completing the ACE programme revealed an enhancement of classroom practice, learner outcomes, and professional identity. However, these results did not fully prove that arrow 1 of the theoretical framework was realized for all the teachers (Clarke & Hollingsworth, 2002). Arrow 1 of Figure 3.3 is an enactive arrow linking the external domain to the domain of practice. This says the results did not indicate that professional development directly influences the classroom practice of the teachers in the current study. The final chapter, Chapter 7, discusses the findings, new knowledge based on the findings, implications and limitation of the study.

CHAPTER 7 : SYNTHESIS

7.1 INTRODUCTION

The results of the study were presented in Chapters 5 and 6. In this chapter, the research question is revisited, followed by a discussion of the contribution to new knowledge, implications, and limitations of the study. Figure 7.1 provides a diagrammatical overview of the chapter.

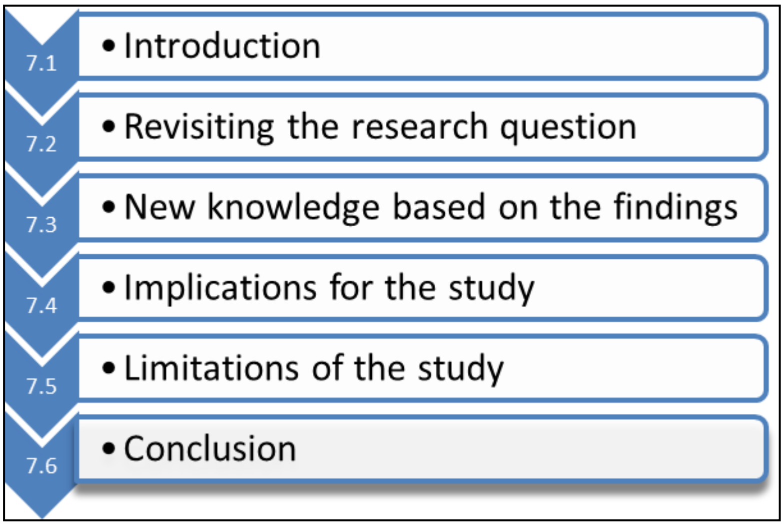


Figure 7.1: A diagrammatical overview of Chapter 7.

The aim of this study was to explore science teachers' views about their classroom practice after completing an ACE programme, and to probe to what extent the outcomes of the programme had been achieved. As indicated in Chapter 1, Section 1.4, in order to achieve this aim, an in-depth qualitative, multi-case study was undertaken, engaging four teachers who had completed an ACE NS programme at a specific South African University, which was the Service Provider. The data were collected by interviews, lesson observations and document analysis.

Chapter 1 outlined the introduction, background, significance of the study, and also explained the concepts used in this study. Chapter 2 presented an overview of the literature where professional development programmes internationally and nationally were discussed. The classroom practice in terms of teachers' subject knowledge, practical competence in conducting experiments, language skills and pedagogical skills were discussed. Furthermore, literature on professional identity was reviewed, as it was found in Section 2.6 that professional identity is linked to classroom practice. Chapter 3 dealt with the theoretical framework of the study. Other models of teacher professional development were also discussed. In Chapter 4, the research design was discussed, focusing on the research paradigm underpinning the investigation, the sample selection, data collection, data analysis, trustworthiness of the study, and the ethical considerations. Chapter 5 presented the analysis of the documents from the Service Provider and the DoE. The discussion in Chapter 5 focused on the envisaged outcomes of the ACE NS programme, as reflected in these documents. Chapter 6 was an analysis of the data collected in the schools through the interviews, lesson observations, the teachers' documents, as well as the learners' workbooks. In Chapter 7, the research question is revisited, followed by discussions of how the study contributes to new knowledge. Finally, the implications and limitations of the study are presented, followed by concluding remarks.

7.2 REVISITING THE RESEARCH QUESTION

The main research question outlined in Chapter 1, Section 1.6 reads: How do teachers view their classroom practice after completing an ACE programme, and to what extent have the outcomes of the programme been achieved? In this section, the findings are discussed in terms of the research sub-questions. The main research question is then finally addressed. The research sub-questions read:

- What are the outcomes envisaged by the ACE programme?
- What does these teachers' actual classroom practice comprise?
- What did the teachers expect to learn in the ACE programme?
- What do teachers think they really learnt in the ACE programme?
- How can the teachers' classroom practices be explained?

Finally, the main research question will be discussed based on the findings emanating from the research sub-questions.

7.2.1 What are the outcomes envisaged by the ACE programme?

To establish what the envisaged outcomes of the ACE programme were, the documents of the DoE and Service Provider were analysed, as explained in Chapter 5. The Norms and Standards for Educators (DoE, 2000) indicated that the goal of the ACE programme was to upgrade the qualifications of teachers and to re-skill those teachers who needed to change specialisations. No specific outcomes were specified for the ACE programme in the DoE documents. However, the DoE documents described the seven roles of educators that needed to be considered by the providers of the ACE programme when designing these programmes. These seven educator roles guided the study as envisaged outcomes of ACE. The DoE envisaged teachers who would be able to fulfil the seven roles of educators in practice, which are:

- Being as subject/learning area/phase specialist;
- Being a learning mediator;
- Being an interpreter and designer of learning programmes and material;
- Being a leader, administrator and manager;
- Being part of a community, fulfilling citizenship and a pastoral role; being a scholar, researcher and lifelong learner; and
- Being an assessor (DoE, 2000, p.13-14).

The realisation of these roles was to be demonstrated by three competencies, namely, practical, foundational, and reflexive competencies (Section 5.2.1).

In addition, it was found that the Service Provider listed 11 goals of the ACE programme (Service Provider, 2013). These 11 goals were found to be aligned with the seven roles of educators, as discussed in Section 5.4.2. Similarly, the course content offered by the ACE programme was found to be aligned with the seven roles of educators (Section 5.4.1). The ACE programme modules specified content that was similar to that listed in the NS Learning Area statement (Section 5.4.3). Furthermore, the Service Provider's modules were designed to support the 11 goals of ACE, as envisaged by the Service Provider (Section 5.4.4).

In the discussion below, the findings on the alignment between the visions of the DoE and the Service Provider are presented. The Service Provider's 11 goals for the ACE programme are used to organise the discussion, showing how the DoE's seven roles of educators align with these goals. The modules presented by the Service Provider are also mentioned to demonstrate how the programme supported the DoE's envisaged outcomes.

Goal 1: Competently apply the knowledge, skills, values, principles, methods and procedures relevant to their subject, Learning Area, or specialism.

The first goal of the ACE programme listed by the Service Provider is aligned wiith five educator roles, namely: being a learning mediator, interpreter and designer of learning programmes and material, part of a community, fulfilling citizenship and a pastoral role, being an assessor, as well as a Learning Area specialist (Table 5.3). Teachers would be able to competently apply the knowledge, skills, values, principles, methods and procedures relevant to their subject when assuming these five roles. Table 5.4 indicates the four content modules, Life and Living, Energy and Change, Planet Earth and Beyond, as well as Matter and Materials, which support goal 1. These modules were focused on the scientific content taught in Grade 7 according to the RNCS (DoE, 2002). Teachers were expected to demonstrate these competences as the achievement of this goal.

Goal 2: Continue to broaden and deepen their knowledge of content, skills, values and ways of thinking in their subject, learning area or specialism in ways that promote their teaching and their learners' learning.

The second goal of the programme listed is aligned with four educator roles: being a learning mediator, scholar, researcher and lifelong learner, as well as an assessor (Table 5.3). Fulfilling these roles would demonstrate the achievement of this goal. The content modules, namely, Life and Living, Energy and Change, Planet Earth and Beyond, as well as Matter and Materials support this goal (Table 5.4).

Goal 3: Continue to develop their pedagogical content knowledge and skills to provide a foundation for their teaching.

The third goal of the ACE programme, as set out by the Service Provider, is aligned with five educator roles: being a learning mediator, interpreter and designer of learning programmes and material, being a scholar, researcher and life-long learner, part of a community, fulfilling citizenship and a pastoral role, as well as being an assessor (Table 5.3). Teachers who demonstrate the achievement of this goal would be fulfilling these roles by facilitating learning, developing learning material, assessing learning, as well as being involved in community services and providing learning support to individual learners. It was found from the analysis of the Service Provider's documents in Chapter 5 that the modules, namely, curriculum in context, curriculum development, approaches to learning and teaching, classroom assessment, learning and teaching science, and learning and teaching resources supported this goal (Section 5.4.4, Table 5.4). Teachers who have completed these modules are expected to demonstrate the achievement of this goal.

Goal 4: Understand principles underlying the curriculum and curriculum change, and how knowledge is selected for the curriculum.

The fourth goal of the programme is aligned with three educator roles: being an interpreter and designer of learning programmes and materials, being a leader, administrator and manager, as well as a Learning Area specialist (Table 5.3). It was found from the analysis of the Service Provider's documents in Chapter 5 that the modules curriculum in context, curriculum development, classroom assessment, learning and teaching science, as well as learning and teaching resources supported this goal (Section 5.4.4, Table 5.4). The completion of these modules would support understanding the underlying principles of the curriculum and curriculum change, and how knowledge is selected for the curriculum.

Goal 5: See links between theory and practice and use theory as a tool to understand, think about and solve problems in their school/workplace and within broader educational and community contexts.

The fifth goal is aligned with three educator roles, namely: being a scholar, researcher and lifelong learner, part of a community, fulfilling citizenship and a pastoral role, as well as being an assessor. Teachers who demonstrate the achievement of this goal would be lifelong learners. They would also study formally towards acquiring a qualification or informally through conducting research for professional development. In addition, they would design assessment activities for learners, as well as participate in solving problems in the school and in the community. It was found from the analysis of the Service Provider's documents in Chapter 5 that the modules, namely, curriculum in context, curriculum development, approaches to learning and teaching, classroom assessment, learning and teaching science, and learning and teaching resources supported this goal (Section 5.4.4).

Goal 6: Engage in classroom and school/workplace-based research.

The sixth goal is aligned with two educator roles: being a scholar, researcher and lifelong learner, as well as part of a community, and fulfilling citizenship and a pastoral role. Just like in goal 5, the achievement of this goal could be evident when teachers assume the role of being a scholar, researcher and lifelong learner, as well as part of their community, fulfilling citizenship and a pastoral role. It was found from the analysis of the Service Provider's documents in Chapter 5 that the modules, namely, curriculum in context, curriculum development, approaches to learning and teaching, classroom assessment, learning and teaching science, and learning and teaching resources supported this goal. School based research could be observed when teachers search for information from various resources to enhance their knowledge, or conduct action research to improve their practice.

Goal 7: Reflect on cultural, social, political and economic issues in relation to subject content and barriers to learning.

The seventh goal is aligned with two educator roles, namely: being a scholar, researcher and lifelong learner, as well as part of a community, fulfilling citizenship and a pastoral role (Table 5.3). When teachers reflect on cultural, social, political, and economic issues in relation to subject content and barriers to learning, they would be demonstrating the achievement of this goal. The document analysis revealed that the content modules, namely, Life and Living, Energy and Change, Planet Earth and Beyond, Matter and Materials, as well as curriculum in context support this goal. This is depicted in Table 5.4. It is during lesson preparations and teaching and learning where the achievement of this goal could be demonstrated.

Goal 8: Communicate effectively in visual, written or alternative modes in the classroom, community and in their academic studies.

The eighth goal is aligned with five educator roles: being a learning mediator, interpreter and designer of learning programmes and material, being a leader, administrator and manager, being a scholar, researcher and lifelong learner, as well as being part of a community, and fulfilling citizenship and a pastoral role (Table 5.3). The achievement of this goal could be demonstrated when teachers mediate learning, interpret and design learning programmes, as well as assume leadership in managing their subjects and learning. It was found from document analysis that the modules of Life and Living, Energy and Change, Planet Earth and Beyond, Matter and Materials, as well as learning and teaching resources, as shown in Table 5.4, support this goal.

Goal 9: Be able to extend their academic literacy in further study through understanding and using effective study methods, including accessing libraries and using a range of appropriate technology.

The ninth goal is aligned with two educator roles: being a scholar, researcher and lifelong learner, as well as being a Learning Area specialist. Teachers were expected to extend their academic literacy in further study through understanding and using effective study methods, including accessing libraries and using a range of appropriate technology when fulfilling these educator roles. It was found from the document analysis that all of the content modules support this goal.

Goal 10: Understand career paths in education and take a leadership role in enabling and fostering collegial and co-operative ways of working among educators.

The tenth goal is aligned with two educator roles: being a leader, administrator and manager, as well as being part of a community, and fulfilling citizenship and a pastoral role. The demonstration of the achievement of this goal could be evident when teachers participate and assume leadership in cluster activities. However, this study was not designed to probe the teachers' understanding as related to career paths. Chapter 5 demonstrated that the modules, namely, curriculum in context, curriculum development, classroom assessment, approaches to learning and teaching, learning and teaching science, and learning and teaching resources supported this goal.

Goal 11: Take initiative in and responsibility for themselves, their work, communities and the broader natural and social environment.

The 11th goal is aligned with four educator roles, namely: being a learning mediator, scholar, researcher and lifelong learner, being a leader, administrator and manager, as well as being part of a community, and fulfilling citizenship and a pastoral role. When teachers mediate learning and assume leadership, manage learning and participate in cluster meetings, they would be demonstrating this goal. It was discussed in Chapter 5 that the modules, namely, curriculum in context, curriculum development, classroom assessment, approaches to learning and teaching, learning and teaching science, and learning and teaching resources supported this goal.

Consequently, the seven educator roles envisaged by the DoE were indeed addressed by the goals outlined by the Service Provider for the programme. It was explained in Section 5.4.2, and in this section, that each goal addressed more than one of the seven educator roles. In addition, the modules supported the 11 goals of the ACE programme. It was also established that there was more than one course supporting the goals of the ACE programme. In conclusion, the DoE envisaged seven educator roles as outcomes for the ACE programme and the Service Provider offered a programme that was well align with these outcomes.

7.2.2 What does these teachers' actual classroom practice comprise?

To explore the actual classroom practices of the teachers, the observed lessons as well as the appropriate documents were analysed. Classroom practice is one of the four domains that underpin the theoretical framework of this study. This section synthesises the classroom practices observed during the study, although it is not claimed that all of these practices result from the ACE programme. The themes used to organise the discussion were: teacher's subject knowledge, practical competence in conducting experiments, pedagogical skills, language skills, and lastly, beliefs about and attitudes towards teaching science.

The teachers who participated in the study were observed presenting and explaining to learners the content on which the lessons were based. The lesson observations revealed that the four teachers displayed adequate subject knowledge in the topics that they taught. The findings were positive, which supports Dahar and Faize (2011), who propose that adequate subject knowledge is essential to teaching science. Furthermore, it was found in the learners' workbooks that the feedback that was given was accurate (Section 6.3.3.1; 6.4.3.1; 6.5.3.1; 6.6.3.1). Therefore, it appears that the teachers did have adequate subject knowledge to teach science at this level. It is therefore concluded that the subject knowledge taught in the ACE programme supplemented the teachers' previous subject knowledge, enhancing their professional identity, and supporting their classroom practice in accordance with the theoretical framework (Clarke & Hollingsworth, 2002).

Three of the four teachers who participated in the study demonstrated adequate skills in conducting the relevant investigations. They arranged resources in advance for the lessons where practical work was conducted, despite being challenged with a lack of apparatus in their schools. Three of the four teachers, Mr Wakithi, Mr Mashangura, and Mr Zulu, were restricted by a lack of resources to implement some of the practical skills learnt in the ACE programme. Despite lacking resources, they displayed adequate skills in improvising as they used improvised resources whenever it was necessary to conduct practical work in the classroom. Mr Mashangura bought engine oil to demonstrate to learners the separation of the mixture of oil and water (Section 6.4.2.2). He displayed a positive attitude, and a commitment to teaching learners to understand scientific concepts. As Bell and Gilbert (1994) explain, teachers who are concerned about their teaching continually seek ways of improving learner outcomes by spending their time and financial resources improving themselves. Mr Wakithi, Mr Mashangura and Mr Zulu were prepared to conduct investigations; in particular, Mr Mashangura spent his own money on materials to conduct practical work with the learners. Together with these positive results, it transpired from the analysis of the learners' books and teachers' planning that most of the practical activities in the learners' workbooks were conducted during the lesson observation periods (Section 6.3.3; 6.4.3; 6.5.3; 6.6.3). This also reveals that they did not regularly conduct practical work.

Ms Ntombela, who was the only participating teacher with a laboratory in her school, was not seen conducting any practical activities. In fact, she indicated that the laboratory was far away and teaching time was lost by bringing the apparatus to the classroom. Dillon (2010) found that some teachers in Germany did not conduct practical work because these are not assessed in examinations, and in the UK, some teachers do not conduct experiments due to large class sizes, a lack of resources, and a lack of qualified and skilled science teachers. In Brazil, practical work is not a prerequisite for admission into university (Dillon, 2010).

Abell and Lederman (2007) explain that the reasons why some teachers do not carry out practical work is because this work was not done when they were learners themselves. They are therefore teaching science the way it was taught to them. In contrast, Muwanga-Zake (2001) relates this reluctance to do practical work to a lack of understanding of scientific concepts. This does not necessarily suggest that Ms Ntombela was taught science without the use of experiments, or that she lacks an understanding of scientific concepts. Nevertheless, it could imply that she was not confident enough, especially as she indicated that she did not have sufficient skills to conduct experiments. The analysis of the teachers' documents and records, as well as the learners' workbooks, revealed that Ms Ntombela gave learners written tasks based on practical work (Section 6.3.3.1; 6.4.3.1; 6.5.3.1; 6.6.3.1). It is also possible that the actual practicals were not conducted, but learners were still given written work based on the practicals that were supposed to be conducted.

It was found that the participating teachers in this study demonstrated a variety of pedagogical skills. Learners were afforded opportunities to work on tasks together in groups under the supervision of the teachers, with the exception of Ms Ntombela. Three of the four teachers, for example, allowed learners to work in groups and learn from one another when conducting practical activities. The learners also worked in groups while the teachers monitored them by moving from desk to desk. There was cooperative learning observed, except in Ms Ntombela's case as she only used direct instruction as a teaching strategy.

The four participants all used continuous assessment to assess learners where oral questioning and classwork, as well as homework were given to the learners. The analysis of the documents revealed that the learners were also given the district summative assessment quarterly. A cover page of such an assessment is depicted in Figure 6.1. It was also found that constructivist teaching principles were utilised by the participating teachers. They all managed to relate what they taught to real life examples. This was found specifically when Mr Wakithi taught about acids and bases, as he went further to present acid rain formation and information on the impact that acid rain has on the environment. Mr Mashangura taught about the separation of waste and related this lesson to the role of recycling in real life. While Mr Zulu taught about mixtures, he referred the learners to mixtures they were familiar with at home. In teaching about directions, Ms Ntombela referred to the uses of compasses, which the learners were familiar with (Section 6.3.2.2; 6.4.2.2; 6.5.2.2; 6.6.2.2).

Teachers used visual strategies, such as reading, as well as different teaching methods, thereby addressing the various learning styles of learners. Mr Wakithi, Mr Mashangura and Mr Zulu used different teaching strategies, such as direct instruction and group work, where learners were engaged in practical activities. However, Ms Ntombela mainly taught using direct instruction. In terms of questioning, it was also found from the lesson observations that learners were mainly asked questions that required lower order thinking (Section 6.3.2.2; 6.4.2.2; 6.5.2.2; 6.6.2.2). This was confirmed in the analysis of the learners' workbooks. Furthermore, it was found that none of the learners in the four cases asked questions in class. In one particular case, this was in contrast with the claims made by Mr Zulu during the interviews that learners had started asking questions to challenge how much he knew (Section 6.5.1.5).

The findings on language skills were that the teachers presented lessons in a way that supported the learners' language development. It was found that all of the teachers requested their learners to read notes aloud either from the chalkboard or from the textbook. This practice was widely used in the pre-1994 classroom, but was later abandoned with the introduction of OBE in South Africa. According to Mouton, Louw and Strydom (2012, p.1213), "There was widespread ignorance as the new curriculum moved away from the crucial basics like reading, writing and arithmetic to a learner-centred approach". Later, the introduction of the Foundation for Learning Campaign (FFLC) resuscitated reading across the curriculum (DBE, 2008). Therefore, in the current study, the reading skills of learners in the science classroom were supported in all four cases. This finding was in contrast with that of Villanueva (2007), who found that science teachers did not want to teach reading in science. It was also found that three of the four teachers in the study code-switched whenever learners struggled to understand the LoLT. As soon as learners understood, these teachers explained again in the LoLT. Mr Mashangura was the exception, as he did not code-switch at all. He taught and explained scientific concepts in English, yet his learners were able to follow his instructions and write tasks as required.

In terms of the theoretical framework, the attitudes that teachers display in the classroom are indicators of their professional identity (Clarke & Hollingsworth, 2002). The confidence that they displayed and spoke about during the interviews was indeed visible during the classroom observations. Three of the four teachers who participated in the study believed in themselves as teachers of science, for example, as indicated earlier, Mr Wakithi moved from desk to desk and challenged learners by asking them questions while they were engaged in practical activities. Mr Mashangura explained scientific concepts without referring to his textbook or notes. Mr Zulu challenged learners to ask him questions. Mr Zulu also displayed a positive attitude towards teaching science, which was evident in that he attended his classes despite being sick. Ms Ntombela, however, displayed a lack of confidence, even though she indicated in the interview that she had learnt some content in the ACE programme, "Phases of matter like solid, liquid, gas". These attitudes are indicators of how teachers' professional identities are reflected in their classroom practice, which is in accordance with the theoretical framework of this study (Clarke & Hollingsworth, 2002).

7.2.3 What did the teachers expect to learn from the ACE programme?

In terms of the theme programme outcomes, it was found in the interviews that the four participating teachers were of the opinion that the Service Provider and the DoE wanted to impart knowledge and skills through the ACE programme. Mr Wakithi expected to learn more skills from the ACE programme, saying “Oh I say they wanted to improve my skills, teaching styles, to love for science more, so that we equip ourselves with more strategies”, he also explained, “Ehh. I will say it was expected of me to make my classroom to be more friendly”. These utterances from Mr Wakithi’s interview transcript were evidence of what he expected to learn from the ACE programme.

Mr Mashangura stated, “It is to upgrade my qualification and also to have more knowledge of teaching.” This was his response when asked what he thought the DoE wanted him to learn from the ACE programme. Furthermore, he said that the Service Provider wanted, “To further my own professional deve deve…lopment and help me to meet the challenge of the teaching and learning.” It seems that Mr Mashangura expected to learn knowledge and skills in the ACE programme that would enable him to teach and facilitate learning in the science classroom.

Mr Zulu indicated that the Service Provider and DoE wanted him to be more practical in teaching science, saying, “I think they want me to be… hence I’m saying I must be more practical. Whereas in our case it’s a challenge because we don’t have facilities to make these learners do practical.” The quotations from Mr Zulu’s interview show that he expected to learn to do more practical work with the learners after completing the ACE programme.

Ms Ntombela remarked that the Service Provider wanted to empower her with teaching and learning skills. She was asked what she thought the DoE wanted her to learn from the ACE programme, to which she replied “In order to develop skill of teaching and, ja, to develop the skills of teaching”. She also explained that the Service Provider wanted, “To develop the skills of learning and teaching for my kids”. Evidently, Ms Ntombela expected to learn the skill of teaching and facilitating learning after completing the ACE programme.

Consequently, the four teachers who participated in this study expected to learn skills from the ACE programme that would enhance their classroom practice. These expectations are aligned with the theoretical framework of this study in terms of enhanced professional identity, which contributes to improved classroom practice.

7.2.4 What do teachers think they really learnt in the ACE programme?

The teachers in this study believed that their classroom practice had changed for the better after completing the ACE programme. They all indicated that they had mastered new subject knowledge, practical skills, and pedagogical skills from the ACE programme.

Mr Wakithi, for example, said that he had learnt about puberty, as related to the life and living course in the ACE programme. He also mentioned content related to the planet Earth and beyond course, namely, “stars”, which he was taught about in the ACE programme. In his own words, “I was taught about the puberty age all in details I was taught more about the stars some are gases some are liquids there is one that is missing oh I will not get deeper”. However, he acknowledged that he needed development in the content related to the planet Earth and beyond core knowledge strands. Moreover, he thought that he still needed more development in practical skills, “I still need to improve and gain more practical skills.” It was found that Mr Wakithi was conscious of the knowledge and skills that he still needed to acquire. Furthermore, he explained that he had learnt about collaboration in the ACE programme, and stated, “We were taught about togetherness you have to involve colleagues in class…The practice I learnt from ACE was this collaboration among ourselves.” It was found that Mr Wakithi mentioned “togetherness” at different times during the interviews, suggesting that he valued collaboration, which indicates that he strongly believed in the value of collaboration. Mr Wakithi thought he had become a better teacher through the ACE programme, responding, “I wouldn’t say better (laughing) I know the basic content. I know how to go around it. I can see someone even utilize my skills which I have learnt from ACE. The thing of hypothesising, all in all I can give my service” Section 6.3.1.7).

Mr Mashangura did not mention any specific subject knowledge he thought he had learnt in the ACE programme, however, he displayed confidence that his subject knowledge had improved after completing the ACE programme. Mr Mashangura answered “Yes” in responding to whether he had sufficient subject knowledge to teach science. His response regarding practical skills was also a resounding “yes” as he thought he had learnt practical skills in the programme. He also clarified that, “The role of learners under constructivism eh. ..I also learnt about theorist like ... Vygotsky.” Mr Mashangura learnt from the ACE programme about a lesson development template. This was evident when he said, “They support me and develop me they give a lesson development frame to do lesson preparations.”

Mr Zulu thought he had learnt subject knowledge and skills that changed his classroom practice. He was asked if his subject knowledge had changed after completing the ACE programme, to which he replied, “Ja, it has changed drastically”. Mr Zulu did not mention specific subject knowledge, but was confident that his subject knowledge had improved; this was evidenced as he said “Yes” three times in his response. Furthermore, he emphasised that he had learnt to do practical work with the learners. He explained, “You know when we were trained in ACE course they-they trained us more practical things, that we must apply practicality since science is more practical,” he added that, “I have learnt a lot about the practical part of science. I was not a fan for before I attended ACE everything was practical than theory.” Mr Zulu was also of the opinion that he had learnt some pedagogical skills in the ACE programme in terms of helping learners to hypothesize before they engaged in a practical activity.

Ms Ntombela’s perspective was also that she had learnt content and pedagogy in the ACE programme, for example, she thought she had learnt some scientific concepts, “Like matter I understand more matter I did not understand before but while I took i-ACE I understand more matter, most of the time.” In addition, she cited “Phases of matter like solid, liquid, gas” when asked about what she had learnt in the ACE programme and had started practicing in her classroom. She also indicated that she had learnt to hypothesize, “Like ah question of hypothesis.”

The views of three of the four participating teachers were that they had developed their practical skills, subject knowledge and pedagogical skills through the ACE programme. This indicated a growth in their professional identity, and according to the theoretical framework, would be reflected in their classrooms (Clarke & Hollingsworth, 2002). This finding supports Borko’s (2004) argument that teachers should have sufficient subject knowledge to mediate the learning of concepts. Mr Wakithi, for example, thought that he still needed development in practical skills. According to the theoretical framework that underpinned this study, the four teachers acquired information from the ACE programme as an external source of information. They understood that the information they had learnt from the ACE programme was meant to be utilised to improve their classroom practice (Clarke & Hollingsworth, 2002). This information enriched their teacher professional identity, and improved them in terms of subject knowledge, practical skills and pedagogical skills.

7.2.5 How can the teachers' classroom practices be explained?

The teachers' observed classroom practice is explained in terms of an understanding of how they view their practices in relation to the envisaged programme outcomes. To be able to explain the teachers' classroom practices lessons were observed, documents analysed and teachers were interviewed. The results indicate that teachers' classroom practices were enhanced by their improved knowledge and skills, their enjoyment of the programme, confidence and positive attitudes, as well as improved learner outcomes. It also transpired that the resource needs inhibited the improvement of classroom practice in three of the four cases. The views and actual practices of the teachers indicated that the change in classroom practice was mainly brought through the changes to professional identity, and learner outcomes. There was little indication, however, of the direct implementation of what was learnt in the programme, for example, Mr Mashangura used the lesson plan template provided during the programme.

The views and actual classroom practice of the four teachers indicated that their knowledge and skills had improved from the programme. For three of the four teachers, their practical skills had improved. Mr Wakithi said he had developed practical skills, however, he indicated that he needed to improve even further. Mr Zulu stated, "I have learnt a lot about the practical part of science". The knowledge and skills acquired from the ACE programme enhanced their professional identity, which motivated them to improve their classroom practice. This was evident in Mr Wakithi's statement, " I know the basic content. I know how to go around it. I can see someone even utilise my skills which I have learnt from ACE." Mr Mashangura indicated that he had learnt some practical skills. Alternatively, Ms Ntombela only referred to improving her subject knowledge, and not practical skills.

Three of the teachers indicated that they enjoyed teaching science more after completing the ACE programme. Mr Wakithi claimed that he enjoyed the Life and Living content, and in one incident, he continued teaching after the end of the class period, "I was going and going when I was stopped by another teacher." Mr Mashangura admitted that he enjoyed the subject more because before completing the ACE programme he did not have enough skills. Furthermore, he also expressed that he had become more comfortable performing scientific investigations, "I enjoy doing experiments". Mr Zulu stated that he enjoyed doing practical work with the learners more than before the ACE programme. Consequently, one could therefore conclude that a better understanding of certain concepts that were dealt with in the

ACE programme made teaching science more enjoyable for these teachers. Their enjoyment of the programme contributed to a growth in their professional identity, resulting in a positive attitude and enjoyable classroom experience.

It was found that three of the four participating teachers could not implement all of the skills acquired in the ACE programme due to a lack of resources (Section 6.3.1.3; 6.4.1.3; 6.5.1.3). Mr Wakithi, for example, emphasised during the interview that he struggled to teach the content on Matter and Materials due to a lack of resources. Mr Mashangura linked his difficulty in teaching “acids and bases” to the lack of a laboratory, and not to a lack of knowledge and skills. Mr Zulu also cited a lack of laboratory as his challenge in teaching science. While Mr Wakithi, Mr Mashangura and Mr Zulu did not have sufficient apparatus to do experiments, they explained during their interviews that they improvised. They were indeed observed improvising to enable learners to conduct practical activities. Unlike these three teachers, Ms Ntombela’s challenge in conducting experiments was not related to resource needs (Section 6.6.2.2), as she had a laboratory at her school. She indicated that the laboratory was too far away and fetching apparatus wasted teaching time. When asked if she believed that she had sufficient practical skills to do the prescribed experiments in Grade 7, she simply said “No”. This indicated that she did not have adequate practical skills, despite claiming in the interviews that she regularly conducted experiments. When her lessons were observed, this claim could not be confirmed.

Three of the four teachers who participated in the study showed confidence in teaching science (Section 6.3.1.6; 6.4.1.6; 6.5.1.6; 6.6.1.6). Mr Wakithi stated that he had become more confident, which was evident when he moved from desk to desk explaining to the learners. Moreover, his confidence was evident from his aspiration to be an examiner for NS Grade 7 for the fourth term in the school cluster. Mr Mashangura was confident as he was observed explaining scientific concepts to learners who did not understand. Mr Zulu responded that he was confident in teaching science, “I can answer any question in as far as science is concerned.” At the other extreme, Ms Ntombela was generally found to be lacking in confidence, and seldom displayed it. In fact, she only demonstrated confidence when teaching using direct instruction with the textbook or notes. Consequently, it can be concluded that the professional identities of the participants had developed, with the exception of Ms Ntombela. They had all experienced growth in the personal domain, albeit differently. Ms Ntombela was reluctant and hesitant to change from traditional teaching using a textbook only. She displayed a pessimistic attitude in teaching science, and resorted to reprimanding the learners. In three of the four cases, it can be concluded that the effects of their enhanced professional identity enabled improved classroom practice, which is in accordance with the theoretical framework (Clarke & Hollingsworth, 2002).

In terms of the theoretical framework, increased classroom practice and improved professional identity both lead to improved learner outcomes. The learners' outcomes were expected to be enhanced as measured in terms of attitudes, behaviour and performance. However, learner outcomes were not directly investigated because they were beyond the scope of this study. Nevertheless, according to the views expressed by the teachers, there was improvement in learner outcomes (Section 6.3.1.5; 6.4.1.5; 6.5.1.5; 6.6.1.6). They claimed that the ACE programme had made an impact on learner outcomes, specifically the learners' attitudes. It was found from the lesson observations that the learners were cooperative and well behaved. Mr Mashangura and Mr Zulu shared positive opinions of learner outcomes. Mr Mashangura explained, "Ok...the participation of the learners is high you understand and when also when you give them the work you have no stress, because they will do it." Mr Zulu said that 60% of his learners were obtaining high marks before he completed ACE, which augmented to "definitely 80 to 90".

In turn, the learners' improved attitudes and performance contributed to these teachers' willingness to work harder. Mr Wakithi and Ms Ntombela expressed that not all of the learners had changed. According to the theoretical framework of this study, the improved learner outcomes contribute to improved classroom practice (Clarke & Hollingsworth, 2002). When Mr Wakithi, for example, was asked if his classroom practice had changed, he said, "Ma' am, it has changed because now kids are more eager to learn science", he added that the learners had begun to enjoy science. Mr Mashangura stated, "They want to concentrate ...in order to challenge the question asked in class", which made Mr Mashangura work harder as a science teacher. Mr Zulu appreciated the learners' responses to his new classroom practice, saying "Ah... they are 100%, Ja ... the feedback is good, Ja", he further said that when teaching, he added "extra knowledge" based on what he was teaching. Ms Ntombela responded, "No most of them are not struggling but some little learners." Although Ms Ntombela described some learners as naughty, learners being disruptive was not observed during her lesson presentations. Nevertheless, she spent teaching time reprimanding them for not paying attention. To the contrary, she also explained that learners enjoyed her lessons when she was "active".

In Ms Ntombela's case, there was no specific learner outcome that was found to inspire her to work harder. It seems that she did not change, but continued in the vicious cycle of traditional classroom practice and poor learner outcomes (Feiter *et al*, 1995). Clearly, the views of teachers illuminated how learner outcomes influence their professional identity as well as classroom practice, in accordance with the theoretical framework (Clarke & Hollingsworth, 2002).

7.2.6 Main research question: How do the teachers view their classroom practice after completing an ACE programme and to what extent have the outcomes of the programme been achieved?

The main research question will now be discussed, explaining how teachers' views of their classroom practice, as well as how their actual classroom practices reflected this change and contributed to the achievement of the envisaged outcomes of ACE. Having already established the agreement between the envisaged outcomes of the DoE and the Service Provider, the DoE's stated outcomes will be used as envisaged outcomes of the ACE programme in this discussion, these comprise the seven roles of educators. The teachers' views and their actual classroom practice are now discussed in terms of these educator roles so as to explore the alignment between their views about their practice, their actual practice, and the envisaged outcomes.

Educator role 1: Being a subject specialist

It was found that the views and the actual practices of the teachers in terms of their classroom practices depicted them as subject specialists, at least at the level of teaching the Grade 7 science curriculum. All of the participants held the view that their subject knowledge had improved. Mr Wakithi stated that he had been taught puberty, and had learnt more about planet Earth and beyond in the ACE programme. He also said that he had attained some practical skills, but added that he still required improvement in terms of his subject knowledge and practical skills. Mr Mashangura viewed himself as having sufficient subject knowledge to teach NS after completing the ACE programme. He also viewed himself as having sufficient practical skills to conduct experiments. Mr Zulu thought his subject knowledge had improved, and that he had learnt practical skills after completing the ACE programme. Ms Ntombela claimed that she had learnt "phases of matter" from the ACE programme, yet, she indicated that some learners still struggled to understand the same content. It was found during the lesson observations that the four teachers explained concepts appropriately to the learners, indicating that they had adequate subject knowledge.

The observed classroom practice of these teachers also revealed that they indeed had sufficient subject knowledge to teach science at Grade 7 level. It is not claimed that the teachers learnt all of their knowledge and skills from the ACE programme, but they indicated that they had learnt more during the programme. Mr Wakithi, for example, said he had learnt subject knowledge from previous NS workshops, as well as from the ACE programme. Furthermore, three of the participants had learnt to be more practical in their approach to teaching science, particularly Mr Zulu.

Educator role 2: being a learning mediator

The four teachers who participated in the study facilitated learning as learning mediators in their classrooms. Their views and actual classroom practice demonstrated the achievement of goal 1. This was evident in mediating learning as they presented the lessons. It appeared that they were able to apply the relevant knowledge and skills. It was found that each teacher created learning experiences for their learners, for example, Mr Wakithi conducted demonstrations and experiments, as well as requiring learners to read notes. Mr Mashangura also created opportunity for learners to do practical activities, and required them to read notes from the board; Mr Zulu required learners to make models of a volcano, conducted a demonstration, and also required learners to read notes from the chalkboard. Ms Ntombela asked questions that learners had to answer orally, she also required them to read from their textbooks, however, she lacked the ability to mediate practical skills.

Mr Wakithi, Mr Mashangura and Mr Zulu were observed using demonstrations and practical activities to mediate learning. Mr Mashangura claimed to be helping learners who struggled to understand by using pictures as teaching aids. Mr Zulu's view was that he should "expose" learners to practical skills for them to learn science. He said that he had been taught to be "more practical" in the ACE programme, and that previously he was not that "practical". He further explained that his learners had begun to perform better and enjoyed science. Ms Ntombela was of the opinion that she taught using different teaching methods to accommodate all learners. However, she was observed using only direct instruction with a textbook to teach. She also thought that her learners enjoyed science more when she was "active". In contrast, she was not observed conducting any demonstration for the learners at any point in the observed lessons.

As learning mediators, these teachers demonstrated through their views and actual classroom practice the partial achievement of goal 7 (see Section 7.2.1). This partial achievement was evident when they used practical examples to explain scientific concepts, for example, they gave practical illustrations and examples to assist learners when they struggled to understand content. When Ms Ntombela taught about plate movement, she explained using pictures of plate movement from the textbook. In addition, when Mr Wakithi taught about acids and bases, he conducted a demonstration. It appeared that Mr Wakithi, Mr Zulu and Mr Mashangura reflected on social and economic issues in relation to their subject, and barriers to learning. Whenever they requested learners to bring resources from home for hands-on activities, they did not penalise those learners who could not bring these materials, instead, they organised the learners into groups such that even the learners who could not bring resources from home participated in the practical activity. This indicated that, as learning mediators, they considered the socio economic status of the learners in teaching science.

These teachers' actual classroom practice also demonstrated the partial achievement of goal 5 (see Section 7.2.1). The four teachers' actual classroom practices revealed that they could see links between theory and practice in terms of teaching learners to use real life examples, and what was familiar to them. This indicated that as learning mediators, these teachers applied a constructivist learning theory in their classrooms, in fact, Mr Mashangura mentioned during the interview that he learnt about constructivism in the ACE programme. Three of the four teachers displayed the understanding that learners have some knowledge and skills, and are able to learn from one another in group work. This understanding was demonstrated when learners were allowed to work in groups when performing practical activities.

Educator role 3: Being an interpreter and designer of learning programmes and material

Teachers' views on their classroom practice, as well as their actual classroom practices, depicted them as interpreters and designers of learning programmes and material**.** All four teachers indicated that they planned lessons using the work schedule provided by the district, but they did not mention the curriculum policy statements (Sections 6.3.1.4; 6.4.1.4; 6.5.1.4;

6.6.1.4). They selected activities from textbook and material sourced from the internet, gave these to learners as written activities. Their lesson plans indicated resources like textbooks, teaching aids and content on which the lessons focus on. Hence, they were to a limited extent, interpreters of learning programmes, and designers of learning material where they decided what materials to use in facilitating learning.

The four teachers' views and actual classroom practice demonstrated that they were able to "communicate effectively in visual, written or alternative modes in the classroom, community and in their academic studies" as goal 8 stipulates. This was evident when they were observed using visual materials. Three of the four teachers conducted demonstrations, and allowed learners to perform hands-on investigations. Mr Wakithi used apparatus to conduct a demonstration for the learners. Mr Mashangura used pictures, drawings and resources, as well as conducting demonstrations. In Mr Zulu's case, the resources used were brought by the learners from home. Ms Ntombela used drawings in the textbook to explain scientific concepts. She also showed learners an example of a real object, a compass, although the learners did not conduct hands-on investigations. It can be concluded that the four teachers were able to communicate effectively in visual, written or alternative modes in the classroom.

Educator role 4: Being a leader, administrator and manager

The views and actual classroom practices of the teachers who participated in this study created the impression that they were fulfilling this role. They were observed managing their classrooms, resources and learning activities. However, this was done differently for the four teachers. For example, Ms Ntombela did not manage the resources available at her school. Three of the four teachers assumed leadership roles, and planning ahead. This was observed when they requested learners to bring resources from home. Their interviews also depicted them as willing to take on leadership in the school clusters because of their growth in professional identity. Mr Wakithi indicated that he was willing to be an examiner in the fourth quarter, and Mr Mashangura revealed that he was a cluster leader, and later that he had become a rugby coach in the school. Mr Zulu explained that he trained teachers on the CAPS dcoument and had assisted teachers in the school as well. Ms Ntombela admitted that she was willing to share the knowledge and skills acquired in the cluster of schools. The theoretical framework indicates a relationship between the professional identity and the external domain (Clarke & Hollingsworth, 2002), which was reflected in these teachers' views.

Their views, however, demonstrated the partial achievement of goal 10 (see Section 7.2.1). As already indicated, Mr Wakithi revealed that he had learnt collaboration from the ACE programme, and was participating in the cluster of schools. Mr Mashangura indicated that he used to be a cluster leader, worked with other teachers in the cluster of schools. Mr Zulu indicated that he was training other teachers on the CAPS document. Ms Ntombela responded that she was willing to help other teachers in the cluster. Clearly, according to their views, assuming "...a leadership role in enabling and fostering collegial and co-operative ways of working among educators" was achieved. It is concluded that the goal was partially achieved since the first part of the goal, namely, to understand career paths in education, was not investigated. The researcher did not obtain information about their career path because it lies beyond the scope of this study. The four teachers were still on post level one, which is the lowest level in the teaching profession, and their highest qualification was the ACE programme.

The teachers' views and actual practice demonstrated the achievement of goal 11 (see Section 7.2.1). The four participating teachers seemed were responsible for themselves and their work as they were at school in all the visits made by the researcher. They further indicated that they were willing to help in the cluster of schools, which was their school community. Mr Wakithi revealed that he had a passion for the environment, and that he encouraged learners to take care of and love the environment as "brothers and sisters". Mr Mashangura went to the extent of buying the resources to conduct a demonstration from his own money. Mr Zulu attended his classes despite being sick with flu. This indicated the attitude and commitment that these teachers had in teaching science. However, Ms Ntombela did not demonstrate initiative and responsibility in bringing the resources that would have enabled her to conduct practical work to her classroom prior to the lesson.

Educator role 5: Community, citizenship and pastoral role

There was no clear observation made, or documents found as evidence that the four teachers were part of a community, and fulfilled a citizenship and a pastoral role. It is acknowledged that this educator role may not have been achieved because there was no evidence found in either the teachers' interviews or documents and records that pointed to the fulfilment of this role.

Educator role 6: Scholar, researcher and lifelong learner

The four teachers' views indicated that they fulfilled this role to some extent. They all indicated that they planned the lessons before implementing them in class. They all had lesson plans in their files, which indicated scholarly activity in gathering relevant information from different sources. Goal 2 (see Section 7.2.1) was partially achieved as two teachers explained that they used textbooks to plan lessons, while the other two indicated that they also used the internet to plan lessons. Mr Wakithi used "old" textbooks for reference, and Ms Ntombela used textbooks, from which she also allowed the learners to read notes. Mr Mashangura and Mr Zulu used the internet and textbooks when planning their lessons. However, there was no evidence that the participating teachers engaged in formal learning. Nevertheless, it is acknowledged that learning that broadens and deepens knowledge of content, skills and values could be informal as well It was thought that planning lessons would include reading other textbooks, searching the internet, and researching information. It is argued that interacting with the textbook or using older textbooks as references, and searching the internet when planning lessons is part of being scholars, researchers and life-long learners. However, none of the four teachers furthered their studies formally after completing the ACE programme, as noted at the time of this study (Section 4.3).

The actual classroom practice of the teachers also demonstrated that goal 3 (see Section 7.2.1) was partially achieved by the participating teachers, although none of them were formally studying further after completing the ACE programme. They all indicated that they regularly participated in cluster activities with other schools where best classroom practices were shared. It is participation in such activities, as well as in workshops, that continually assisted them to develop their pedagogical content knowledge and skills. Moreover, their views and actual practice demonstrated the partial achievement of goal 4 (see Section 7.2.1). The teachers did not fully demonstrate the achievement of this goal, for example, none of the four teachers mentioned the use of curriculum policy documents when planning lessons. They only mentioned the work schedule, textbooks and the internet. The four teachers demonstrated that they understood the underlying principles of the curriculum and curriculum change as they indicated the learning outcomes and assessment standards in the lesson preparations. The formal written tasks given to their learners also indicated the learning outcomes and assessment standards assessed. However, there were no instances observed where the four teachers demonstrated how knowledge is selected for the curriculum, or actual participation when the curriculum is changed. In fact, this was not explored because the focus of this study was on classroom practice.

It was found that the teachers' views and actual classroom practice did not demonstrate the achievement of goal 6 and 9. Neither the teachers' views nor their actual classroom practice indicated that these goals were achieved, however, it was not investigated as these goals are beyond the scope of this study.

Educator role 7: Assessor

The actual practice of the participating teachers indicated that they fulfilled the role of being an assessor as they assessed the learners continuously orally, as well as in writing. The learners were mainly assessed orally in the beginning of the lessons, as well as during the lessons. In addition, learners were given written work. In most of the lessons, the teachers were observed giving the learners written work to assess their understanding of the content. The written work was given to learners at the end of each period. Thus, the four teachers demonstrated the fulfilment of this role in assessing learners.

From the discussion, it is clear that the teachers' views, as well as their actual classroom practice, were found, to a large extent, to be aligned with the envisaged outcomes of the ACE programme. While all the teachers agreed that the programme contributed to improved knowledge, not all of them reported improved classroom practice. Three of the teachers displayed enthusiasm, positive attitudes and confidence about their improved knowledge and skills. The classroom practice observed for these teachers were mostly in line with the envisaged outcomes of the ACE programme. Alternatively, one teacher lacked confidence and displayed a negative attitude, which was reflected in her traditional classroom practice. These observations clearly demonstrate how the enhancement of professional identity generates enhanced classroom practice. The teacher professional development programme assisted the four teachers in different ways, which is in agreement with Borko's (2004) finding that teachers are influenced in different ways during a professional development programme. Furthermore, the teachers' personal attitudes and commitment influenced their views and actual science classroom practices.

7.3 NEW KNOWLEDGE BASED ON THE FINDINGS

This section elaborates on the findings discussed in Section 7.2. The discussion is presented in terms of professional growth, teachers' concerns about resources, the Hawthorne effect, alignment between the teachers' views, their practice and envisaged outcomes, as well as the contribution of this study to the literature, and the profession as a whole.

7.3.1 Professional growth

According to the theoretical framework, a professional development initiative impacts classroom practice through direct implementation, as well as indirect processes of enactment and reflection, which involve professional identity and learner outcomes (Clarke & Hollingsworth, 2002). Figure 7.2 shows the links between the programme, classroom practice and professional identity, as suggested by Clarke and Hollingsworth (2002). In this study, the views as well as actual classroom practice of the four teachers revealed that it was not the direct implementation of the programme skills that improved their classroom practice. It is in this regard that "not observed" is indicated next to the arrow from the ACE programme to classroom practice in Figure 7.2. Rather, it enhanced professional identity, which contributed substantially to enhanced classroom practice. This is illustrated by the link between professional identity and classroom practice in Figure 7.2.

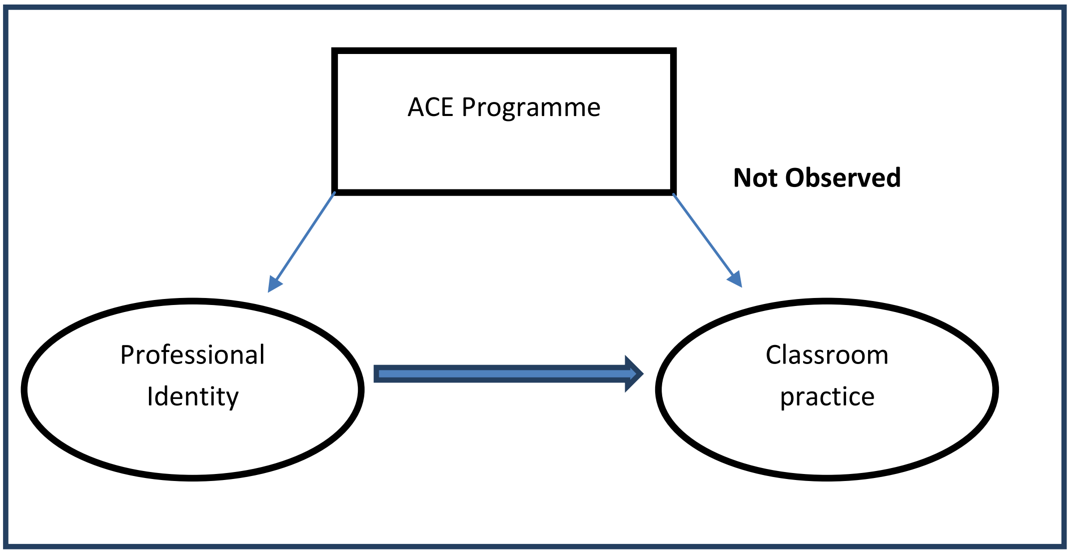


Figure 7.2: The ACE programme enhanced professional identity, which resulted in improved classroom practice, while the direct enactment of skills learnt in the programme was not observed.

However, the ways in which teacher professional development occurred depends on the unique personalities and circumstances of the teachers. This is in agreement with Borko (2004, p.6), who found that teachers responded to professional development differently, “Some teachers change more than others through participation in professional development programmes”. This personal influence is fundamental to teachers’ professional identity. Mr Wakithi, for example, displayed confidence and enthusiasm when explaining that he had learnt new content and skills in the ACE programme. During the lessons, he displayed similar confidence, a positive attitude, knowledge, pedagogical skills, and practical skills when presenting content and conducting demonstrations, showing that his professional identity and classroom practice had developed (Section 6.3.2.2). Mr Mashangura also displayed a positive attitude during the interview. He explained that he learnt about the constructivist learning theory in the ACE programme; he was observed implementing this in the classroom through the use of resources that were familiar to the learners during demonstrations on separating mixtures (Section 6.4.1.6; 6.4.2.2). This suggested that his improved professional identity resulted in growth in his classroom practice. Mr Zulu was observed attending classes even on days when he was sick, which demonstrated his commitment and positive attitude towards teaching science (Section 6.5.2.2). These examples show that these three teachers had experienced an enhancement of their professional identity following the programme. These enhanced skills and positive attitudes motivated them to improve their classroom practice, as represented in Figure 7.2. Alternatively, Ms Ntombela seldom displayed confidence during the interviews or the lesson observations, and she indicated that her classroom practice did not change. From these observations, it is concluded that changes in classroom practice can be explained by the degree of enhancement of teachers’ professional identities.

This conclusion supports Desimone’s argument that professional development is mediated by the development of professional identity (Desimone, 2009). Further evidence of enhanced professional identity was found in three of the teachers’ willingness to cooperate and lead in teacher cluster activities, for example, Mr Wakithi stated, “ I can see someone even utilize my skills which I have learnt from ACE.”, he then added, “I am looking forward to be an NS examiner for the fourth term”. Mr Mashangura revealed, “In the cluster we plan together, we set common paper together”. Mr Zulu explained that he participated as one of the trainers in the NS CAPS training.

In terms of learner outcomes, the views and actual classroom practice of the teachers indicated that it was not only their classroom practice that influenced learner outcomes, but also their enhanced professional identity. These influences are depicted in Figure 7.3, which shows part of Clarke and Hollingsworth (2002) model. Mr Wakithi, for example, reported that the learners were more eager to learn science (Section 6.3.1.5), and ascribed it to his improved confidence, “The word confident is not enough. I am more confident” (Section 6.3.1.6). His improved confidence, which was part of his professional identity, increased learners’ eagerness to learn science. He also confidently demonstrated the acid and bases tests and then encouraged learners to test household substances in groups (Section 6.3.2.2). The learners participated in practical activities, and responded to questions. Mr Wakithi even said, “Learners do not want me to go out from their classroom sessions”. This served as evidence that the learner outcomes improved in Mr Wakithi’s case because of his improved professional identity and enhanced science classroom practice. Mr Mashangura demonstrated confidently in class how the mixture of oil and water can be separated. He also planned for learners to conduct a recycling activity outside the classroom, after explaining the instructions. This suggests that his classroom practice and professional identity were enhanced. Subsequently, his learners enthusiastically participated in the recycling activity (Section 6.4.2.2). The learners’ response to questions and participation in practical activities served as evidence that the learner outcomes improved. Furthermore, he indicated that, “learner participation is high” (Section 6.4.1.5).

Mr Zulu confidently demonstrated to learners how to determine an eastward direction in one of his lessons. Thereafter, he requested the learners to demonstrate this so that he could assess if they understood. The learners also responded to questions, conducted demonstrations themselves, and participated in practical activities in Mr Zulu’s case. This provided evidence of enhanced learner outcomes resulting from improved professional identity and classroom practice. Moreover, Mr Zulu mentioned an improvement in learner performance, in that “80 to 90” percent of his learners were getting higher marks after he had completed the programme (Section 6.5.1.5). In his perspective, it was his improved knowledge and beliefs, as part of his professional identity, that enhanced learner outcomes. However, these claims of improvement were not verified in this study as the focus was on classroom practice. These three teachers’ views and actual classroom practices clearly suggest that improved learner outcomes were a result of the change in their classroom practice, as well as their enhanced professional identity, as illustrated in figure 7.3. Alternatively, Ms Ntombela thought that some learner outcomes had changed, but she was not confident about it (Section 6.6.1.5).

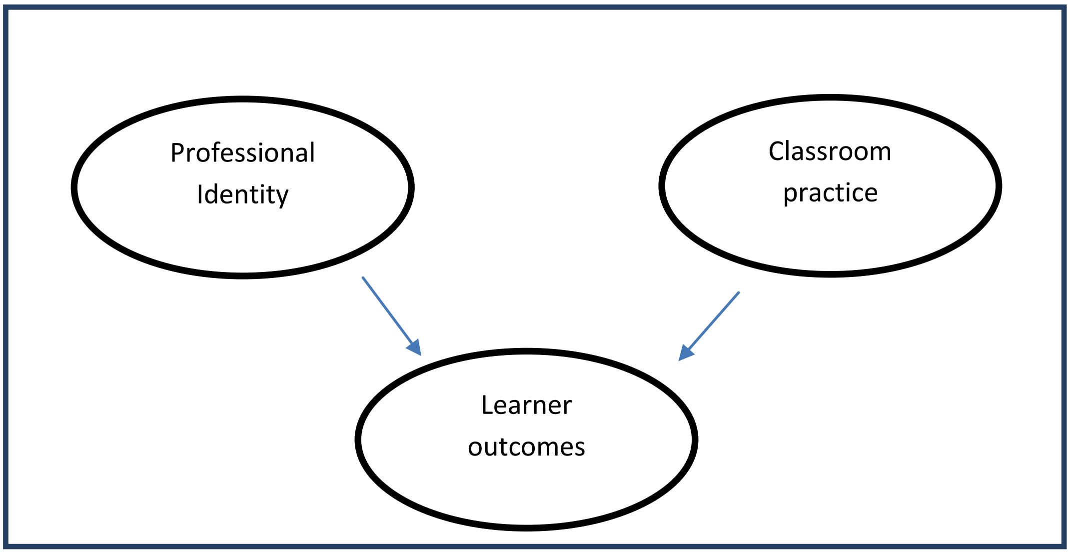


Figure 7.3: Improved learner outcomes resulting from enhanced classroom practice and enhanced professional identity (Adapted from Clarke & Hollingsworth's (2002) model)

The views and actual classroom practice of these teachers revealed that the reverse processes also occurred, as illustrated in Figure 7.4. The reverse processes indicate that the improved learner outcomes reinforced growth in classroom practice, and in teachers' confidence, for example, in Mr Wakithi's classroom, the learners' eagerness to learn enhanced his professional identity and classroom practice, he pointed out that, "You have to go deeper and seek more information" (Section 6.3.1.6). In addition, the teachers' views and actual classroom practice revealed that the growth in classroom practice, in return, led to enhanced professional identity. When the teachers successfully implemented new ideas in their lessons, they gained more confidence and experience, which further enhanced professional identity.

This is illustrated in figure 7.4 by the link between classroom practice and professional identity. Mr Zulu's learners were observed cooperating when they demonstrated erupting volcanoes, when participating in practical activities, and when they brought resources from home. The cooperation and positive attitudes from learners enhanced the teacher's confidence and professional identity. This process is represented by the arrow from learner outcomes to professional identity in Figure 7.4. Mr Zulu expressed that he had begun to excel in teaching science, revealing his confidence. Even Ms Ntombela, although hesitant, said that the learners enjoyed science when she was "active". However, this did not encourage her enough to improve her classroom practice and professional identity. Hence, the processes depicted in Figure 7.4 were not observed in Ms Ntombela's case.

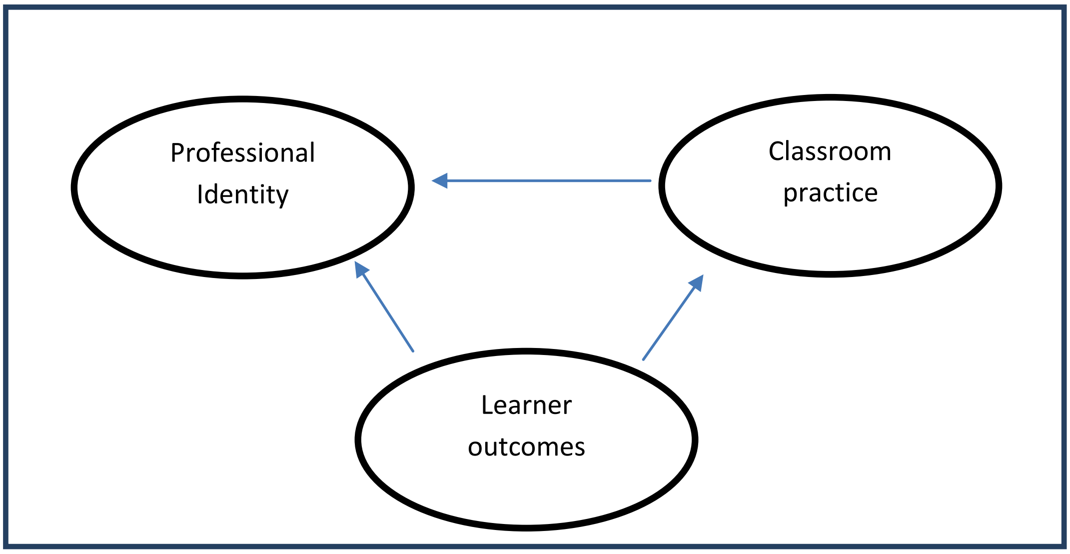


Figure 7.4: Improved learner outcomes reinforced the enhanced professional identity and improved classroom practice.

Combining the results represented in Figures 7.2 to 7.4 leads to a new model, as shown in Figure 7.5. On the whole, it has emerged from the views and actual classroom practices of the teachers that the knowledge and skills learnt in the programme directly enhanced their professional identity. This subsequently led to improved classroom practice. The double arrows in Figure 7.5 linking professional identity and science classroom practice indicate that the improved classroom practice in turn reinforced growth in the teachers' professional identity. Teachers' enhanced professional identity also contributed directly to improved learner outcomes. In return, the improved learner outcomes reinforced the teachers' professional identity and improved the science classroom practice of the teachers. Therefore, this study recommends the model depicted in Figure 7.5, which combines aspects of Desimone's (2009) model and the model of Clarke and Hollingsworth (2002).

In the new model, improved classroom practice and learner outcomes are the observable outcomes of a professional development initiative, but these outcomes are also the products of an enhanced professional identity. Furthermore, the model incorporates positive feedback from improved learner outcomes, reinforcing improved classroom practice and enhanced professional identity.

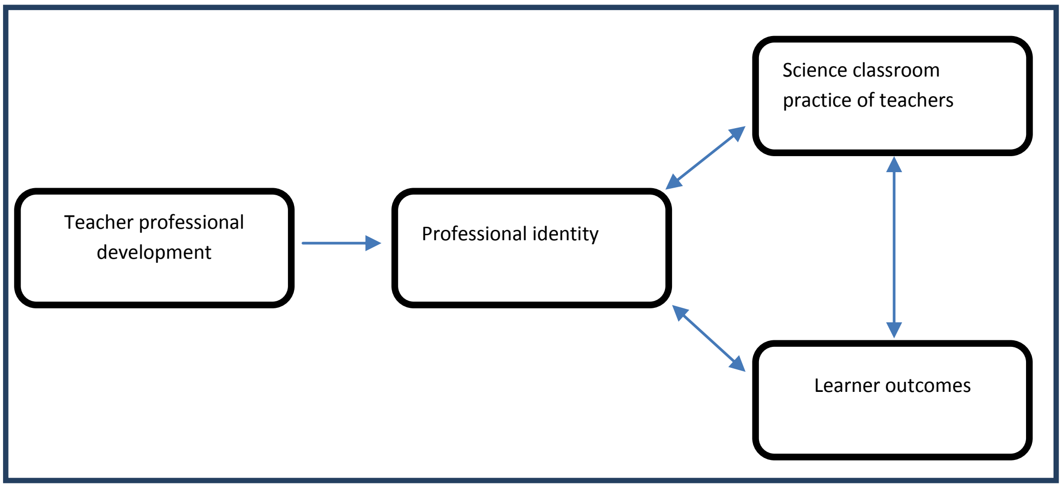


Figure 7.5: A suggested model for teacher development

7.3.2 Teachers' concerns about resources

It is concluded that three of the four participants were restricted by a lack of resources in their schools to implement some of the knowledge and skills learnt (Section 6.3.1.3; 6.4.1.3; 6.4.1.3). The challenge they experienced is similar to what Buczynski and Hansen (2010) have established in their study that teachers struggle to implement knowledge and skills learnt in a professional development programme when there is a lack of resources. Johnson *et al.* (2000) propose that teachers need resources to teach science. This was evident when three of the four teachers were asked in the interviews if they had sufficient subject knowledge to teach NS, their responses focused on the lack of a laboratory and resources instead (Section 6.3.1.2; 6.4.1.2; 6.5.1.2). Furthermore, when asked if they had the practical skills to conduct experiments, their responses revolved around the lack of resources, for example, Mr Wakithi said, "Going out to the local tuckshop and buy ..."; Mr Mashangura explained, "I told you that we are lacking", and Mr Zulu revealed, "We do not have a laboratory and the apparatus to perform those experiments" . He needed apparatus, saying, "No, no, the whole science kits, if they bought the whole science kits because it has all the apparatus inside". Clearly, they were seriously concerned about the need for resources.

Two of the teachers mentioned logistical problems related to resources. When asked during the interviews if they had enough apparatus to conduct experiments, Mr Wakithi's response was, "No, no, no, maybe I can say the reason is the storage, there is minimum storage" and

Mr Mashangura responded by saying, “You will find that they are put in a cupboard they are not on one place, you suppose to come with them on time to put in class”.

Ms Ntombela’s case was unique because there was a laboratory with apparatus in her school. She was not concerned about a lack of apparatus, but she did complain about the location of the laboratory, saying it was too far from the classrooms.

Overall, the views of three of the four participants revealed that they were overwhelmed by the lack of resources, and were consequently unable to implement all the knowledge and skills learnt.

7.3.3 The Hawthorne effect

The ACE programme did not fully develop the commitment of these teachers to conduct practical work consistently. This was found when the documents revealed that more practical activities were conducted during the data collection period of this study than before it (Section 6.3.3; 6.4.3; 6.5.3). Three of the participants were observed conducting practical work and demonstrations. However, these teachers performed most of the practical work during the weeks of lesson observation, but very little earlier in the year prior to data collection. This may be an illustration of the Hawthorne effect, as explained by Wickström and Bendix (2000). These authors explain that respondents change behaviour when they are aware that they are being studied. This is in agreement with Leonard and Masatu (2006), who find that respondents become more productive during experimentation. These authors found that their respondents regressed after the research was completed. Therefore, it is possible that the enhanced classroom practice of the three teachers who conducted practical work may have gradually regressed after the research had been completed. Alternatively, the experience of successful improvising may have good long-term results. It is argued that teachers in this study could have realised their potential in conducting practical work when they were observed, and that they may be inspired to continue this practice.

7.3.4 Alignment between teachers’ views, their practices and the envisaged outcomes of ACE

It is concluded that, to a large extent, there was alignment between the teachers’ views, their actual classroom practice, and the envisaged outcomes of the ACE programme (DoE, 2000). The outcomes of the ACE programme that were not achieved were not part of classroom practice, but were related to community involvement and further study.

The findings of this study under Section 7.2.6 discussed the fact that the teachers' actual classroom practice provided evidence of the partial fulfilment of most of the educator roles. However, there was no evidence in their actual classroom practice that they had assumed the roles of being involved in the community, and studying formally towards a qualification. This is not surprising as the focus of the study was on classroom practice.

7.3.5 Contribution of the study

It is concluded that this study contributes towards the body of knowledge in teacher professional development in science education, especially on how teachers view their science classroom practice after completing a teacher professional development programme. Furthermore, this study has provided knowledge through research about what teachers expect to learn from a science teacher development programme. Furthermore, light has been shed on how they explain their classroom practice after completing a teacher development programme. It has also been revealed that even after teachers have completed a teacher professional development programme, some of them may still cling to old traditional science classroom practices. Although the results of this study cannot be generalised, the study can give in-depth understanding and enhance knowledge of the way a teacher professional development programme influences the views of teachers on science classroom practice.

The exploration of the views of teachers on their science classroom practice has opened a window into teachers' professional identity. In fact, exploring the views of teachers was a useful strategy to gain insight into teachers' professional identity, which provided valuable information about the processes of teacher professional growth. This has led to the new model of teacher professional development, as outlined in Figure 7.5. The study has therefore contributed to new knowledge in the literature on professional development.

7.4 IMPLICATIONS OF THE STUDY

In view of the findings discussed in the study, recommendations regarding professional development programmes are discussed. Some suggestions for further study are also presented in this section.

7.4.1 Recommendations to the Service Provider of a teacher development programme

The findings of this study revealed that not all of the teachers were able to implement the knowledge and skills acquired in such a programme. The Service Provider of a teacher development programme could consider packaging future teacher development programmes such that follow-up support visits are done up to at least a year after teachers have completed the programme. In other words, professional development programmes should be structured in a way that supports teachers who have completed the programme. This recommendation is in line with Banilower *et al.* (2007), who find that teachers implement what was learnt in the classroom when they are supported. Support could enable the teachers who have completed the programme to continue implementing what was learnt until the information acquired develops into knowledge that they could implement naturally.

Three of the four participating teachers conducted practical activities with the learners. However, they revealed that they did not have apparatus in their schools to implement what was learnt. In their study, Buczynski and Hansen (2010) found that a supply of resources was given to teachers who completed the Inquiry Learning Partnership (ILP) professional development programme. This was done considering that the teachers did not have the resources to implement what was being taught in the programme in their schools. It is in this regard that future Service Providers could consider packaging a professional development programme such that basic science apparatus and resources are part of the course or programme material for teachers to take and use in their schools. In addition to the apparatus and resources, a booklet containing examples of improvised materials that teachers could utilise whenever they needed to could be part of the package.

None of the four participants were English first language speakers. Their command of the LoLT was limited, and in some instances, poor, as evident in the interview transcripts (Appendix 6, 9, 12 and 15). It is argued in the McKinsey report that "A teacher's level of literacy as measured by vocabulary and other standardised tests, affects student achievement more than any other measurable teacher attribute" (Barber & Mourshed, 2007, p.16). Thus, it is recommended that future teacher development programme designers could incorporate English for the purpose of teaching as one of the modules in the science teacher development programme. This is also in agreement with Harvey (1999), who recommends that teacher professional development should incorporate language skills development to assist teachers to teach science better. This could further enhance the science classroom practice of teachers.

This further echoes Darling-Hammond and Sykes' (2003) argument that verbal skills are one of the factors that influence learner outcomes. Alhough their study was conducted in the USA, similar language issues are applicable in South Africa as well because English is used as the LoLT in most schools in South Africa. All subject teachers in South Africa are further expected to implement the "English across the curriculum strategy", which requires teachers to also teach language in their subjects (DBE, 2013). Language development for science teachers clearly needs to be taken into consideration in future professional development programmes.

7.4.2 Recommendations for teachers who have completed a teacher development programme

It is recommended that teachers who have completed a teacher development programme be encouraged to empower themselves naturally by striving to be scholars, researchers and lifelong learners through reading. It is acknowledge that lifelong learning could be informal through reading journals, science magazines, watching educational programmes, participating in a Professional Learning Community (PLC), or a teacher association. Johnson and Fargo (2010) state, "teachers learn from each other". Attending a PLC or any form of lesson study, for example, could assist teachers to learn from one another and be life-long learners (Huang & Bao, 2006; Lumpe, 2007; Olson, 2005). It is therefore recommended that teachers participate in some form of PLC for their professional development.

Moreover, continued development can be formal through enrolling in a recognised institution of higher learning. Life-long learning could provide teachers with opportunities to keep up to date with the latest policies and information in their area of specialisation. This is supported by Caena (2011, p.2), who suggests that, "Complexities of the teaching profession require a lifelong learning perspective to adapt to fast changes". This could allow teachers to have more information as required for their continual learning, and consequently, their professional growth. Teachers should be encouraged to use current policy documents in the planning of learning activities before considering textbooks, the internet and other resources.

7.4.3 Recommendations for the Department of Education

It is recommended that the DoE provides teachers with the necessary apparatus and other resources required after they have completed a professional development programme. All the resources that the teachers were using during their training could be made available to teachers in schools to strengthen the implementation of new skills. The knowledge learnt from the professional development programme might otherwise not be maximally implemented in the classroom. This is supported by Mayer and Lloyd (2011), who indicate that teacher development programmes that are conducted in training venues are at a disadvantage because sophisticated equipment is often used, while such equipment is not available in schools. When teachers return to their schools, they are unable to implement what was learnt.

One teacher in this study had all the resources required for conducting investigations, but it was found that she did not conduct investigations like the other three teachers, who did not have resources. This indicates that some teachers may need school-based training and support on the use of existing resources. This recommendation is in line with Rogan's (2007) proposal that science teachers need training on the use of apparatus provided in schools. He found in his study that teachers did not use science apparatus and these apparatus were kept in boxes unused. It is recommended that HoDs in schools further support teachers who have completed a professional development programme to encourage the implementation of new skills.

In addition, it is recommended that the DoE creates opportunities of mentoring and coaching of teachers who completed a teacher development programme in districts. Mentoring was found in literature to be useful in enhancing teacher growth (Desimone *et al.*, 2014; Kedzior, 2004; Loucks-Horsley *et al.*, 2010). So, DoE through the districts could develop mentoring policies like it is suggested in the study conducted by Desimone *et al.* (2014). Teachers could have their own choice of mentors in the school who they could easily reach whenever need arises. Desimone *et al.* (2014) referred to these internal mentors as informal. The support by the informal mentors could be supplemented by the ones organised by the district offices, which they refer to as formal.

It is further recommended that the DoE should organise programmes for teachers who have completed a specific professional development programme. In these organised programmes, teachers could share with others in the school and in the cluster of schools. This might strengthen what was learnt and further develop the teachers' knowledge and skills. In addition, it is recommended that teachers who have completed a professional development programme be recognised by being awarded incentives. Incentives may be linked to salary progression, which could also encourage other teachers to continually enroll for professional development programmes to improve their knowledge and skills. Improved knowledge and skills would impact their classroom practice, and ultimately increase learner performance (Desimone, 2009; Yoon *et al.*, 2007).

It was found that the participating teachers did not make use of well-known pedagogical strategies. In terms of questions, the participating teachers mainly asked the learners lower order questions. Only one participant attempted to ask learners higher order questions (Section 6.4.2.2). It is therefore recommended that the DoE should develop and train teachers to ask learners higher order questions. The use of discrepant events (Gabel, 2003) could also be used when teaching science, which was not observed during the classroom observations in this study. The use of discrepant events in science education is well known to promote conceptual understanding and motivate learners to learn science (Chin-Chung, 2000; Gabel, 2003; Longfield, 2009). Addressing misconceptions was not observed in three of the four teachers' lesson presentations. Only Mr Wakithi was observed addressing learners' misconception in one of his six lessons (Section 6.3.2.2). Thus, this study recommends that the DoE should require that important teaching strategies be addressed in science professional development programmes.

7.4.4 Suggestions for further research

Firstly, during the interviews in this study, some teachers indicated that learners had begun to ask questions, however, learners did not ask questions in any of the lessons observed. This raised concern because asking questions is one of the features of constructivist teaching (Savasci, 2006). In a science classroom, learners are expected to ask questions so that in trying to answer these questions, teachers can create learning experiences. Future studies could investigate ways to encourage learners to ask questions in the science classroom.

Secondly, it was found that none of the four teachers who participated in this study were formally enrolled to study further after completing the ACE NS programme. They acknowledged that the ACE programme had developed them, yet they did not further their studies beyond this programme. Further studies could be undertaken to investigate why science teachers do not further their formal studies continuously, despite one of the seven roles of educators being that they should be scholars, researchers and lifelong learners. Is it that they find it sufficient to learn informally from other sources like journals, the internet and textbooks? Does it mean that they are content to learn from PLCs or lesson study in their cluster of schools? This observation can be further investigated.

Thirdly, it was found that three of the four teachers who participated in the study could not implement all of the knowledge and skills acquired in the ACE programme because of a lack of resources in their schools. This is in agreement with the findings of Buczynski and Hansen (2010) in their study, where they focused on the impact of professional development on teacher practice. They found that teachers did not have the resources to implement all of the knowledge and skills acquired in the professional development. Some of the resources the teachers used during the teacher development programme were not available at schools. Future studies could focus on exploring the feasibility of packaging a teacher development programme such that all resources to be used back at the teachers' schools are part of the training material to be provided for each teacher. This suggests that future studies could explore the possibility of a "starter pack" or "tool box" for science teachers. The content of the proposed "tool box" could include basic apparatus that a science teacher would require to teach science. However, a scientific study could investigate the possibility of packaging, as well as how teachers use such a package. Possible research on understanding of practical by learners if any, can be investigated.

Fourthly, in this study it was found that out of the 28 teachers that were contacted to request their participation in the study, 15 indicated that they were no longer teaching NS Grade 7, mentioning different reasons, as discussed in Chapter 4 (Section 4.3). This means that less than half of these teachers continued to teach NS in the Senior Phase after completing the ACE programme. Consequently, it is recommended that a large quantitative study be undertaken to investigate the reasons why teachers who have completed professional development do not continue teaching NS. This might shed more light on whether teachers enrolled for the ACE programme to upgrade themselves, and to be better science teachers who will impact learner performance, or if they were only interested in acquiring a higher REQV in any subject where there was funding available. It could also be investigated if some of these teachers were promoted, or whether they perhaps resigned. It should also be analysed whether the re-skilling of teachers yielded the desired results.

7.5 LIMITATIONS OF THE STUDY

This research was an interpretive case study using a purposively chosen sample. The research sample consisted of four teachers, although they are not a representative sample of the population of teachers who completed the ACE NS programme. Therefore, the findings of this study should not be generalised to the larger population of teachers who have completed ACE NS programmes. However, the study provides insight into how teachers view their classroom practice after completing an ACE programme, and to what extent the outcomes of the programme have been achieved for these teachers. The results may provide useful information to understand the effects of professional development programmes on classroom practice.

The researcher's own beliefs as a science teacher might have influenced her interpretation of the data collected in this study. However, the design of the study as a multiple case study was focused on understanding, rather than generalising the findings. Using three data collection methods contributed to the trustworthiness of the study. Observing six lessons per teacher also assisted in the appropriate interpretation of the data in this study.

Another limitation of the current study is that much of the data reported in chapter 6 is the self-reports of teachers. It is acknowledge that such data are not strong evidence because teachers could give responses in the interview that they believe the researcher wants to hear. However, this was mitigated by the use of three data collection methods as well as the awareness of this limitation assisted when the data was interpreted.

Learners' workbooks were requested for document analysis purpose. The teacher in the classroom selected the learners' workbooks that were analysed. This posed a limitation as the teacher might have selected the workbooks from better performing learners. This limitation was mitigated by requesting a different set of three learners' workbook in each lesson observed.

The views of the teachers and their actual classroom practices before they were enrolled for the programme were never explored. This posed a limitation as there was no prior benchmark against which the entry qualities could be assessed. However, the self-reports of the teachers were supported by the lesson observations and document analysis. It should further be clear that this was not an experimental study, but rather an investigation to understand teachers' practices and the achievement of programme outcomes.

7.6 CONCLUSION

This study has contributed to the knowledge base in understanding how a professional development programme contributes to enhancing the classroom practice of science teachers. The findings of this study may provide new insight for the policy makers and the designers of teacher professional development programmes. The four teachers believed that they had acquired knowledge and skills in the ACE programme that impacted their classroom practice, although in one case, the teacher did not change her practice. It was found that changes in classroom practice could be influenced by growth in teachers' professional identity. This conclusion led to proposing a new model for professional growth.

According to Msila (2014, p.345), "empowered teachers produce better learners". However, as indicated in Chapter 3, it is acknowledged that the teachers' learning would not immediately be translated into knowledge, as change takes time and effort (Guskey, 2002). Darling-Hammond and Sykes (2003) find that it is a combination of factors that improves learner performance. It is therefore understood that the poor performance of science learners will not be completely eradicated at once, despite the implementation of development programmes. This study, however, may provide one step in the ongoing process of improving classroom practice and learner performance.

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APPENDICES

APPENDIX 1: ACE ENVISAGED OUTCOMES

Department of Education's documents extracted from the Norms and Standards for Educators (DoE, 2000).

The envisaged goals of ACE

"The ACE is intended to replace the FDE and the HDE and may be used for up-grading or further training in a specialization or for re-training" (DoE, 2000, p.2).

Educator roles

Norms and Standards for Educators (DoE, 2000, p.13-14) [Also in the new policy (RSA, 2011 p.52-53)].

1. Learning mediator

The educator will mediate learning in a manner which is sensitive to the diverse needs of learners, including those with barriers to learning; construct learning environments that are appropriately contextualized and inspirational; communicate effectively showing recognition of and respect for the differences of others. In addition an educator will demonstrate sound knowledge of subject content and various principles, strategies and resources appropriate to teaching in a South African context.

2. Interpreter and designer of learning programmes and materials

The educator will understand and interpret provided learning programmes, design original learning programmes, identify the requirements for a specific context of learning and select and prepare suitable textual and visual resources for learning. The educator will also select sequence and pace the learning in a manner sensitive to the differing needs of the subject/learning area and learners.

3. Leader, administrator and manager

The educator will make decisions appropriate to the level, manage learning in the classroom, carry out classroom administrative duties efficiently and participate in school decision making structures. These competences will be performed in ways which are democratic, which support learners and colleagues, and which demonstrate responsiveness to changing circumstances and needs.

4. Scholar, researcher and lifelong learner

The educator will achieve ongoing personal, academic, occupational and professional growth through pursuing reflective study and research in their learning area, in broader professional and educational matters, and in other related fields.

5. Community, citizenship and pastoral role

The educator will practice and promote a critical, committed and ethical attitude towards developing a sense of respect and responsibility towards others. The educator will uphold the constitution and promote democratic values and practices in schools and society. Within the school, the educator will demonstrate an ability to develop a supportive and empowering environment for the learner and respond to the educational and other needs of learners and fellow educators. Furthermore, the educator will develop supportive relations with parents and other key persons and organizations based on a critical understanding of community and environmental development issues. One critical dimension of this role is HIV/AIDS education.

6. Assessor

The educator will understand that assessment is an essential feature of the teaching and learning process and know how to integrate it into this process. The educator will have an understanding of the purposes, methods and effects of assessment and be able to provide helpful feedback to learners. The educator will design and manage both formative and summative assessment in ways that are appropriate to the level and purpose of the learning and meet the requirements of accrediting bodies. The educator will keep detailed and diagnostic records of assessment. The educator will understand how to interpret and use assessment results to feed into processes for the improvement of learning programmes.

7. Learning area/subject/discipline/phase specialist

The educator will be well grounded in the knowledge, skills, values, principles, methods, and procedures relevant to the discipline, subject, learning area, phase of study, or professional or occupational practice. The educator will know about different approaches to teaching and learning (and, where appropriate, research and management), and how these may be used in ways which are appropriate to the learners and the context. The educator will have a well developed understanding of the knowledge appropriate to the specialism.

Service Provider's documents (Service Provider, 2013, p.105)

Outcomes of ACE

Name of the course: Advanced Certificate in Education

Qualification Title: Advanced Certificate in Education

Qualification Abbreviation: ACE

Minimum Period of Study: 2 years part time

NQF Exit Level: Level 6

SAQA Credits: 120

Exit Level Outcomes

Qualified practitioners at this level will:

1. Apply competently the knowledge, skills, values, principles, methods and procedures relevant to their subject, learning area or specialism;

2. Continue to broaden and deepen their knowledge of content, skills, values and ways of thinking in their subject, learning area or specialism, in ways which promote their teaching and their learners' learning;

3. Continue to develop their pedagogical content knowledge and skills to provide a foundation for their teaching;

4. Understand principles underlying curriculum and curriculum change and how knowledge is selected into the curriculum;

5. See links between theory and practice and use theory as a tool to understand, think about and solve problems in their school/workplace and within broader educational and community contexts;

6. Engage in classroom and school/workplace-based research;

7. Reflect on cultural, social, political and economic issues in relation to subject content and barriers to learning;

8. Communicate effectively in visual, written or alternative modes in the classroom, community and in their academic studies;

9. be able to extend their academic literacy in further study through understanding and using effective study methods, including accessing libraries and using a range of appropriate technology;

10. Understand career paths in education and take a leadership role in enabling and fostering collegial and co-operative ways of working among educators;

11. Take initiative in and responsibility for themselves, their work, communities and the broader natural and social environment.

The modules that make up the ACE (GET) science from the Service Provider are:

1. Curriculum in Context
2. Curriculum Development
3. Energy and Change This module will deepen and extend your scientific knowledge, skills and attitudes in how energy is transferred in physical and biological systems and the consequences of human needs on energy resources.
4. Matter and Materials. This module will deepen and extend your scientific knowledge, skills and attitudes in the properties and uses of materials, their structure, changes and reactions
5. Life and Living. This module will deepen and extend your scientific knowledge, skills and attitudes in life processes and healthy living, interactions within environments, the importance of bio-diversity and the balance and change in environments
6. Approaches to Learning and Teaching
7. Classroom Assessment
8. Learning and Teaching Science, this module explores and applies various theories and strategies based on research to help improve the learning and teaching of science in an OBE classroom with a special focus on the educator roles of assessor, learning mediator and leader, administrator and manager.

9. Learning and Teaching Resources in Science , this module focuses on the evaluation, analysis, selection, adaptation and development of learning and teaching materials within the science curriculum, as well as exposure to the professional science culture and science community. Special focus is given to the educator roles of interpreter and designer of learning programmes and materials, researcher and life-long learner, as well as community, citizenship and pastoral roles
10. Planet Earth and Beyond, this module will deepen and extend your scientific knowledge, skills and attitudes in the planet Earth in a vast Universe, how the Earth changes over time, and the special features of the Earth which support life.

Admission to the ACE programme (Service Provider, 2013, p.106)

Advanced Certificate in Education (ACE: Upgrading)

H58 Admission

Admission as a student for the Advanced Certificate in Education (ACE: Upgrading*) is at the discretion of the Senate, save that a person may not be admitted as a student unless s/he:

a) Has passed the Senior Certificate with endorsement or has obtained a school leaving certificate and satisfies the Senate that s/he is proficient in English: and either

b) Holds a teaching qualification which involves at least three years of post matriculation training, recognized by the Department of Education of South

Africa (REQV 13**); or

c) Holds a teaching qualification which involves at least two years of post matriculation training, recognized by the Department of Education of South Africa (REQV 12**) and a minimum of three years of experience in the field of education, and who presents a portfolio of work demonstrating his/her level of knowledge and experience in the field of education, which is acceptable to the Senate; and

d) Has a minimum of two years teaching experience which, in the opinion of the

Senate, is adequate for the purposes of the certificate; provided that the

Senate may in a case considered by it to be exceptional, dispense with, or modify the period of teaching experience.

APPENDIX 2: BIOGRAPHICAL INFORMATION FORM

The purpose of the biographical information form is to collect the biographical details of the teachers and the information about the school. This information is anonymous and will be kept confidential.

PART A: Information about the school.

A.1 Description of the building (for an example bricks, corrugated iron)

A.2 Does the school has running water?

A.3 Does the school have electricity?

A.4 Give the overall description of the environment where the school is located

PART B: Information about the teacher.

B.1 Pseudonym:

B.2 Hypothetical name of the School:

B.3 Subjects teaching at the school:

B.4 What is your area of specialization?

B.5 Position held at school (for an example Teacher or Head of Department or Deputy Principal or Principal)

B.6 When did you complete your initial teacher training?

B.7 When did you start teaching NS?

B.8 What is your highest qualification related to Natural Sciences before enrolling on the ACE NS programme?

B.9 Where did you obtain the qualification mentioned in number B.8?

B.10 When did you obtain the qualification?

B.11 What are other highest qualifications that you have? If any

B.12 Where did you obtain the other highest qualifications as mentioned in B.12?

B.13 When did you obtain the other highest qualifications?

B.14 Is there any other thing that you want to tell me about your personal details?

APPENDIX 3: INTERVIEW PROTOCOL

Interview Questions
1. Do you believe that you have sufficient subject knowledge to teach the syllabus? (Possible probing: If yes: Can you give an example of subject knowledge in the syllabus that you struggle to teach? If no: Are there any topics you struggle to teach?)
2. Do you believe that you have sufficient practical skills to do the prescribed experiments? (Possible probing: How often do you do experiments with learners; do you have enough apparatus to conduct experiments, If no, what is needed?; Do you sometimes use improvised materials to do experiments? If Yes, can you give an example)
3. How do you plan lessons? (Possible probing: Can you name information sources you use to plan/prepare for each lesson?)
4. How do you decide which learning activities and instructional materials to use in a lesson (Probing: What do you do when learners are struggling to understand what you are teaching them)?
5. How do you accommodate learners with different learning styles?
6. How do you help learners to understand science when they have difficulty to understand the language?
7. What kinds of experiences do you think enables learners to learn science? (Possible probing: How do you think learning takes place? / What do you think is the best way for learners to learn science?)
8. What do you think the department of education wanted you to learn from the ACE programme?
9. What do you think the university wanted you to learn?
10. How did you think your classroom practice was expected to change after completing the ACE program?
11. Do you think your classroom practice has changed? (Probing question: If yes, which way? If no, what prevents you from changing your practice?
12. Do you think your subject knowledge has improved? (If yes, can you name one science concepts you think you learnt in ACE? If no, why do you think you did not learn anything from ACE?)
13. Can you tell me about something you were taught in ACE which you are practicing in class? (Possible probing: Can you mention any best practice or experience you copied from ACE and you are implementing in class?)
14. Did your learner behaviour in class changed since you completed ACE? (Possible probing: If yes, in which way? If no, why do you think it did not change?)
15. Do you think learners are now enjoying science when you teach now that you completed ACE? (Possible probing question: If yes, can you explain why do you think they are enjoying? If no, what prevent them from enjoying?)
16. Did you enjoy the ACE programme? (Possible probing: Can you name a specific concept that you enjoyed about ACE programme?)
17. Do you enjoy teaching science more than before you completed the ACE programme? (Possible probing question: Can you mention a specific thing you enjoy in teaching

Interview Questions
science?)
18. Do you have more confident in teaching science after completing the ACE? (Possible probing question: How confident are you to share what you were taught in ACE with other teachers in your cluster?)
19. Can you explain the effect of your learners' responses on your new classroom practice? (Do you struggle with learners who do not write home works and submit assignments late?)
20. Would you be willing to share what you learnt in ACE in the cluster meeting? (Possible probing questions: Can you explain how the ACE NS programme has changed the way you believe and view yourself as a science teacher?)

APPENDIX 4: LESSON OBSERVATION SCHEDULE

Date of the observation	
School (Pseudonym)	
Name of the teacher (Pseudonym)	
Subject	
Grade	
Number of learners	
Period number and time	
Lesson topics	

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	
	Is the content explained correctly?	
	Is the teacher able to relate what he taught to real life examples?	
	Is the teacher able to respond to learners' questions correctly?	
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	
	Is the purpose of the experiment clearly stated?	
	Were apparatus checked beforehand for functionality?	

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Was there a worksheet or guideline on what to observe?	
	What was the source of the worksheet or guidelines?	
	Were learners clarified as to what to write on the worksheet?	
	How was the practical work assessed or the experiment assessed?	
	Did learners perform hands-on practical work?	
	Did the teacher conduct practical demonstration?	
	If it was a demonstration, was it visible to all the learners? Explain how	
	What were the learners expected to do after seeing the demonstration?	
	Were the learners assessed to find if they have learnt something from the demonstration?	
Pedagogical skills	Is there continuous assessment?	
	How is the classroom managed?	
	Does the teacher link content to learners’ previous knowledge and context?	

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	How is the interaction of the teacher with learners?	
	How is learner participation, are they actively involved?	
	Is there evidence of cooperative learning?	
	Does the teacher use models/visual examples to explain science concepts?	
	Are the various learning styles of learners accommodated in the lesson?	
	Is the teacher aware of learners' typical misconceptions?	
	Does the teacher use different strategies to teach? Explain how?	
	Does the teacher ask learners questions that cater for the different cognitive levels?	
	How much direct teaching does the teacher use?	
	How does the teacher use the discrepant event to clarify further for learners?	
Language skills	Do the planned learning activities accommodate language skills?	
	Does the teacher code switch appropriately?	

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	
	How is the enthusiasm of the teacher?	
	Does the teacher inspire the learners?	

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners actively participated in question and answer sessions when direct instruction was used.			

APPENDIX 5: DOCUMENT ANALYSIS GUIDE

School (Pseudonym): ___________________________
Document number: ____________________________
Date collected: ________________________________
Importance of the document: To confirm the kind of activities given to learners and the frequency thereof.

Document analysis Guide 1: Learners' workbooks

CRITERIA	Comments
Activities based on practical work	
Frequency of written work	
Accuracy of feedback or corrections given to learners by the teacher;	
Activities that require high order thinking;	
Evidence of various forms of assessment given to learners;	

Document analysis Guide 2: Teacher documents and records (Work Schedule, lesson preparation and programme of assessment**)**

CRITERIA	Comments
Activities in teacher planning that involve practical work	
Science content covered for the grade in the planning	
Learners assessment records, planned for various learning styles	
Recording sheets for the learner performance	

APPENDIX 6: INTERVIEW TRANSCRIPT FOR MR WAKITHI

	Interview Questions	**Description of Code**	**Code**	**Researcher's comments**
Researcher:	Do you believe that you have sufficient subject knowledge to teach the syllabus in Natural Sciences?			He believes he has sufficient subject knowledge to teach the syllabus in Natural Sciences. His response indicated that the knowledge was acquired not only in the ACE programme but from attending the workshops in NS for several times.
Teacher	Yes nginama reason ayi -2 (Yes I have two reasons)			
Researcher	Ohkay			
Teacher:	I attended workshops in NS for several times. Ngiyazama (I am trying) by all means to get new knowledge. I have sufficient knowledge for the subject. There are few challenges with Matter and Materials.	Teacher confidence Teacher's subject knowledge	TC SK	
Researcher	Can you give an example of content you struggle to teach?			I suppose teaching aids like charts where he can show learners for example pictures of models of molecules. He did not specify specific content in Planet Earth and Beyond here but indicated that there is content in Planet Earth and Beyond he is struggling to teach.
Teacher	Matter and Materials yes, Matter and Materials because of 'ama' teaching aids we are struggling to get teaching aids. Some of the things siyazenzela (we make for ourselves) on our own okunye (okunye means others). Some 'zama'-of the experiments they dig more like si-builder ama-molecules, siyazenzela njengezivalo (we make like lids) ama-lids. Some learners do not understand colours in their vernacular iya-then you have to show them, they must see these colours. Vernacular is going to be our struggle coming to Matter and Materials. Another content in Earth and Beyond.	Understanding learners Improvisation Resource needs	UL IMP RN	
Researcher	Ohkay thank you, are there any topics you struggle to teach?			Now here Mr Wakithi specified the content in Planet Earth and Beyond that he is struggling to teach as "volcano". He is struggling to get
Teacher	Another content that I am struggling is volcano that is, Planet Earth and Beyond. I have used, some of the experiments linking them whereby I used tartaric and vinegar trying to explain more but just a matter of getting amamagazines. Some they do understand but some they struggled a lot.	Resource needs Improvisation Understanding learners	RN IMP UL	

	Interview Questions	Description of Code	Code	Researcher's comments
		Resource needs	RN	magazines where he could get pictures to show learners pictures of a volcano for an example.
Researcher	Do you believe that you have sufficient practical skills to do the prescribed experiments?			Here I got a sense that Mr Wakithi was aware of his lack of some practical skills. He acknowledged that he consult with other teachers who conducted similar practical activity in the past.
Teacher	No, no, no the reason is I usually ask some teachers who have done some practical skills to kids after that. Some are more difficult they urge you as a teacher. As I say I am not that good but I am trying. I think I don't have sufficient practical skills; I still need to improve and gain more practical skills. Hence I say I am not that good but I am trying.	Practical skills	PS	
		Collaboration	C	
		Teacher's attitude	TA	
Researcher	How often do you do experiments with learners?			It seemed Mr Wakithi is conducting experiments almost daily from his response to this question because NS in grade 7 had 3 hours per week.
Teacher	I do experiments at least thrice a week if ever maybe they are struggling and not more than four.	Practical skills	PS	
		Teacher's attitude	TA	
Researcher	Do you have enough apparatus to conduct experiments, If no, what is needed?			Though he indicated earlier on that he is doing experiments thrice a week, he is saying here he has minimum storage for apparatus.
Teacher	No no no maybe I can say the reason is the storage, there is minimum storage.	Resource needs	RN	
Researcher	Do you sometimes use improvised materials?			He is using improvised material, including buying some substances like the ones mentioned in his response.
Teacher	I do use improvised material like going out to the local tuck shop and buy tartaric acid, vinegar.	Improvisation	IMP	
		Resource needs	RC	
		Practical skills	PS	
Researcher	Ohkay thank you my next question is: How do you plan lessons?			Mr Wakithi seemed to

	Interview Questions	Description of Code	Code	Researcher's comments
Teacher	I usually plan lesson before going to the classroom. I plan for the whole in terms. In a term I can plan for the lesson that will cater for the whole term. If I have a spare time I plan for the whole term yes. I usually go to my old textbooks, my old textbooks.	Pedagogical skills Teacher's attitude	PDS TA	be organised by planning in advance.
Researcher	How do you decide which learning activities to use in a lesson?			He is following the work schedule. He did not specify how he chooses the activities from the textbooks as he indicated earlier on to be using old textbooks.
Teacher	How do I decide? I decide I usually follow my schedule for the term; I do it on my own.	Pedagogical skills Teacher's confidence	PDS TC	
Researcher	What do you do when learners are struggling to understand what you are teaching them?			Mr Wakithi seemed to be referring to the expanded opportunities offered to learners who are "fast" or those who are "slow". He allows fast learners to assist the slow ones.
Teacher	The system which is called expanded notation whereby you find the slow and fast learners. We usually take the fast learners to assist those that are slow. I usually go to teachers that are familiar to that content.	Pedagogical skills Collaboration	PDS C	
Researcher	Ohkay, how do you accommodate learners with different learning styles?			It seemed like his strategy to accommodate learners with different learning styles was through the use of group work.
Teacher	I usually divide them in groups and ask those who are struggling to come and work with the ones who are progressing well in class.	Understanding learners Pedagogical skills	UL PDS	
Researcher	Ohkay, thank you: How do you help learners to understand science when they have difficulty to understand the language?			In Mr Wakithi's school, there were learners whose home language was Sotho and some IsiZulu and he is Ndebele, probably this was the reason why he would ask teachers
Teacher	I try by all means to go in their standard and ask some teachers encourage them to use the dictionary which is familiar to them usually ask for some teachers who know the language of learners	Collaboration Understanding	C UL	

	Interview Questions	Description of Code	Code	Researcher's comments
		learners		who know the learners' home language.
Researcher	What kinds of experiences do you think enables learners to learn science?			Mr Wakithi seemed to be passionate about nature
Teacher	The love of nature	Understanding learners	UL	
		Teacher's attitude	TA	
		Teacher's belief	TB	
Researcher	Ohkay thank you, What do you think is the best way for learners to learn science?			His response here as well indicated that Mr Wakithi had a positive attitude to the environment.
Teacher	To make them aware that eh that without living organisms which are around us we cannot go anywhere. The environment, whereby the ecosystem go in pollution , I try to convince them that they must love nature like brothers and sisters	Teacher's attitude	TA	
		Pedagogical skills	PDS	
		Teacher's beliefs	TB	
Researcher	What do you think the department of education wanted you to learn from the ACE programme?			He was clear about the intentions of the Department of Education with the ACE programme
Teacher	Oh I say they wanted to improve my skills, teaching styles, to love for science more, so that we equip ourselves with more strategies.	Outcomes of the ACE programme	OAP	
Researcher	Ohkay now, What do you think the university wanted you to learn?			He was also clear about the goals of the Department of Education with the ACE programme.
Teacher	They wanted me to equip me with their new, new strategies which they learn from various institutions	Outcomes of the ACE programme	OAP	
Researcher	Thank you now, How did you think your classroom practice was expected to change after completing the ACE program?			His response indicated his positive attitude towards his classroom.
Teacher	Ehh. I will say it was expected of me to make my classroom to be more friendly.	Outcomes of the ACE programme	OAP	
		Teacher's attitude	TA	
Researcher	Do you think your classroom practice has changed? If yes, which way? If no, what prevents you from			He linked his changed

	Interview Questions	Description of Code	Code	Researcher's comments
	changing your practice?			classroom practice to the eagerness to learn science daily.
Teacher	Mam it has changed because now kids are more eager to learn science each and every day. Everyday learners do not want me to go out from their classroom sessions.	Teachers' beliefs	TB	
		Outcomes of the ACE programme	OAP	
		Learner outcomes	LO	
		Teacher's confidence	TC	
Researcher	Ohkay, Do you think your subject knowledge has improved? (If yes, can you name one science concepts you think you learnt in ACE? If no, why do you think you did not learn anything from ACE?)			Mr Wakithi seemed to have experienced an improvement in the Life and Living subject knowledge. He acknowledged that he was taught about stars as well.
Teacher	Oh Yes, then the science concept was Life and living, ehe…(laughing) I will never forget this part of life and living whereby I was taught about the puberty age all in details I was taught more about the stars-some are gases some are liquids- there is one that is missing oh I will not get deeper.	Teacher's beliefs	TB	
		Teacher's confidence	TC	
		Teacher's subject knowledge	SK	
Researcher	Now can you tell me about something you were taught in ACE which you are practicing in class?			Mr Wakithi emphasised that collaboration was the best practice learnt from the ACE programme.
Teacher	That I am practicing?			
Researcher	Yes and mention any good practice or experience learnt.			
Teacher	We were taught about togetherness you have to involve colleagues in class. I have to mention best practice we were taught about working togetherness where we have to involve colleagues in class we have taught about collaboration among ourselves taught to learn from learners. You have to learn from them. The practice I learnt from ACE was this collaboration among ourselves	Outcomes of ACE of programme	OAP	
		Collaboration	C	
Researcher	Did your learners' behaviour in class changed since you completed ACE?			Mr Wakithi measured

	Interview Questions	Description of Code	Code	Researcher's comments
Teacher	Yes they have changed.	Outcomes of ACE programme Learner outcomes	OAP LO	the improved learners' behaviour by indication that now learners love NS more than any learning area.
Researcher	In which way?			
Teacher	They now love this NS more than any learning area because the results have improved dramatically since I completed ACE.	Learner outcomes Outcomes of the ACE programme Teacher confidence	LO OAP TC	
Researcher	Do you think learners are now enjoying science when you teach now that you completed ACE?			He was of the opinion that from his attending ACE learners are now eager to learn.
Teacher	Eh Ha.I can say from attending ACE my learners have-has improved they are now eager to learn science. Something new each and every day. I even went to the curriculum whereby I was teaching Puberty I was went an extra mile I was going and going when I was stopped by another teacher (He implied it was the next period).	Learner outcomes Teacher's attitude Teacher confidence Learners' attitude	LO TA TC LA	
Researcher	Did you enjoy the ACE programme and can you name a specific concept that you enjoyed about ACE programme? If you did enjoy.			It looked like Mr Wakithi learnt more content in Life and Living.
Teacher	Oh yes I did enjoy the ACE. The content is the whole grade specifically is Life and Living	Teacher's beliefs Teacher's attitude	TB TA	
Researcher	Do you enjoy teaching science more than before you completed the ACE programme?			It seemed like in the ACE programme they were exposed to the use of apparatus, though Mr Wakithi indicated that he still lacks some practical skills
Teacher	Ah…I enjoyed the ACE programme and the reason being that I have been taught to use apparatus which I never used before. The lecturer was so good that she gave us the chance to perform experiments in front of other colleagues. We were corrected whenever we made mistakes, after this programme we were able to correct ourselves.	Practical skills Teacher's attitude Teacher's confidence	PS TA TC	
Researcher	Do you have more confidence in teaching science now that you have completed the ACE?			The response indicated

	Interview Questions	Description of Code	Code	Researcher's comments
Teacher	The word confident is not enough. I am more confident.	Teacher's beliefs Teacher's confidence	TB TC	that he was confident.
Researcher	How confident are you to share what you were taught in ACE with other teachers in your cluster?			Though he indicated that he plans his lessons but the response here indicated that he could teach without a lesson plan because of his confidence.
Teacher	I even forget to make these lesson plans. Hay mam the word confident I don't think is the correct word. I'm even a cluster leader in Daveyton with the confident that I am having I even forget to do these lesson plan.	Teacher's beliefs Teacher's attitude Teacher's confidence	TB TA TC	
Researcher	Can you explain the effect of your learners' responses on your new classroom practice?			Though he felt learners love NS more than any other learning area, he still had challenges of learners who were not submitting work on time.
Teacher	Mam I do struggle a lot with them. Some are struggling to submit more work like in practical task in my Natural Science class. They differ they are not same. There are the ones that submit the work on time. There are the ones that in writing task they struggling a lot, the NS facilitator once told us that in general sometimes we must not focus on spelling error. In general they differ submitting some they write their homework in class some they wait for you to give feedback and fill in work they were suppose to do at home.	Pedagogical skills Learners' outcomes Resource Needs	PDS LO RN	
Researcher	Thank you, would you be willing to share what you learnt in ACE in the cluster meeting?			Though he was a cluster leader, he had ambitions of being an examiner for term 4.
Teacher	Mam I will be willing to share what I have learnt in ACE in cluster meeting because I am still sharing it. I am looking forward to be an NS examiner for the 4th term.	Teacher's confidence Collaboration	TC C	
Researcher	Do you believe and view yourself as a better science teacher?			
Teacher	I wouldn't say better (laughing) I know the basic content. I know how to go around it. I can see someone even utilize my skills which I have learnt from ACE. The thing of hypothesising, all in all I can give my service.	Teacher's confidence Teacher's beliefs Outcomes of ACE programme	TC TB OAP	Mr Wakithi was over confident.

	Interview Questions	**Description of Code**	**Code**	**Researcher's comments**
Researcher	Is there any other thing you want to share with me about the ACE programme as we conclude the interview?			Mr Wakithi was of the opinion that he has learnt that as a teacher he must share with other teachers.
Teacher	I say as I went to the ACE programme what I have learnt as a teacher not of NS but a teacher in general… you must go and ask for more, you must share with other teachers. As I told you about the planets issue some of us are still think there are 9 planets whiles one is gone. You have to go deeper and seek more information. You must network as a science teacher	Teacher's confidence	TC	
		Outcomes of ACE programme	OAP	
		Collaboration	C	
		Teacher's subject knowledge	SK	
		Teacher's attitude		
Researcher	Thank you so much we have come to the end of the interview.			

APPENDIX 7: MR WAKITHI LESSON OBSERVATION TRANSCRIPTS

Mr Wakithi lesson observation number 1

Classroom observation

Date of the observation	13 August 2013
School (Pseudonym)	Waiting Primary School
Name of the teacher (Pseudonym)	Mr Wakithi
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	12h00
Lesson topics	Acids and bases

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content was based on different substances dissolved in water, some becoming acidic solutions and some becoming alkaline solutions. The content was presented correctly.
	Is the content explained correctly?	Mr Wakithi explained the content as learners were reading notes. The teacher explained as the reading progresses.
	Is the teacher able to relate what he taught to real life examples?	Yes he related what he taught to real life examples. The example of producing sour milk by adding tartaric acid to fresh milk was cited by the teacher in this lesson.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions in this lesson. The teacher was asking them questions as they were reading notes. They were asked if water will change the colour of the litmus paper. The learners said no in a chorus.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	The teacher brought laboratory chemicals, apparatus and put them on the table in front. (sodium carbonate, hydrochloric acid, magnesium sulphate, beaker, test tubes, sunlight liquid and water)

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	It was suitable because it is reflected in chapter 5 under the Senior Phase core knowledge and concepts in the RNCS document.
	Is the purpose of the experiment clearly stated?	The purpose was not clearly stated but when the teacher summarised he indicated that some substances when dissolved in water become acidic solutions and some become alkaline solutions.
	Were apparatus checked beforehand for functionality?	The teacher was not observed checking but he seemed to have trialled the experiment in advanced. In the beginning of the lesson all apparatus were packed in the table in front of the class.
	Was there a worksheet or guideline on what to observe?	The worksheet was attached on the handouts with notes for this lesson
	What was the source of the worksheet or guidelines?	The teacher's reference textbook was the source of the worksheet.
	Were learners clarified as to what to write on the worksheet?	Learners were told to indicate which substances dissolved in water when tested will be acidic or basic.
	How was the practical work assessed or the experiment assessed?	The completion of the worksheet attached to the notes was completed to assess the practical work. What are the acidic solutions? When do you get acidic solutions? When do you get basic solutions? Does pure water change the colour of litmus paper? What kind of solution do you get when ammonia is dissolve in water? These were the questions asked.
	Did learners perform hands-on practical work?	They tested given solutions using an indicator.
	Did the teacher conduct practical demonstration?	He demonstrated to the learners how they should test solutions using indicators. He also demonstrated that not all colourless solutions are water.
	If it was a demonstration, was it visible to all the learners? Explain how	The teacher was standing as he demonstrated and all learners could see.
	What were the learners expected to do after seeing the demonstration?	They were expected to test the solutions put in their desks and later in the lesson complete the worksheet.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Were the learners assessed to find if they have learnt something from the demonstration?	There was a worksheet kind of a handout with, learners were expected to respond. The teacher explained how they should answer.
Pedagogical skills	Is there continuous assessment?	There were oral questions to assess learners as the lesson progresses.
	How is the classroom managed?	The classroom was well managed in this lesson.
	Does the teacher link content to learners' previous knowledge and context?	It was evident when learners were asked if soap dissolved in water will be acidic or basic.
	How is the interaction of the teacher with learners?	The interaction of the teacher with the learners was good. Learners were free to interact with the teacher responding to questions.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lessons conducting experiments and answering questions.
	Is there evidence of cooperative learning?	Cooperative learning was evident in this lesson as they were testing the various solutions for acidity and alkalinity, learners were working together.
	Does the teacher use models/visual examples to explain science concepts?	The nature of the lesson was visual as learners were handling apparatus and chemicals. This was observed in the beginning of the lesson.
	Are the various learning styles of learners accommodated in the lesson?	Learners read notes, answered questions posed by the teacher, they tested different solutions and completed a worksheet.
	Is the teacher aware of learners' typical misconceptions?	He was aware that some learners may think that all colourless solutions are water. Learners were to test solution to determine whether they are acidic or basic. Not all colourless solutions are neutral
	Does the teacher use different strategies to teach? Explain how?	Group work and working as individuals when answering questions in the worksheet.
	Does the teacher ask learners questions that cater for the different cognitive levels?	It was not evident in this lesson only questions like 'Is it an acid or a base?'What kind of solution do you get when ammonia dissolves in water? Does pure water change the colour of the litmus paper? These questions were asked.
	How much direct teaching does the teacher use?	This lesson was half direct teaching through reading and the teacher explaining notes then learners tested solutions using an indicator.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	How does the teacher use the discrepant event to clarify further for learners?	It was not observed in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	This lesson accommodated language skills because learners read the notes in the handout. They were reading simultaneously.
	Does the teacher code switch appropriately?	The teacher code switched appropriately in this lesson as he was explaining notes.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	He was confident, he probed learners.
	How is the enthusiasm of the teacher?	The teacher was enthusiastic explaining to learners and demonstrating how testing solutions using an indicator should be done.
	Does the teacher inspire the learners?	Yes the teacher inspired the learners through asking them questions.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners actively participated in testing different solutions	Learners were answering questions as posed by the teacher.	Learners were well behaved and disciplined when working in groups.	In this lesson learners use their workbooks and the provided test tubes and chemicals. The use of apparatus was good, no breakage of test tube was observed.

Mr Wakithi lesson observations number 2

Classroom observation

Date of the observation	14 August 2013
School (Pseudonym)	Waiting Primary School
Name of the teacher (Pseudonym)	Mr Wakithi
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	14h00
Lesson topics	Testing household substances

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content was presented correctly where learners were reminded that indicators are dyes changing colours of solutions depending on whether the solution is acidic or basic.
	Is the content explained correctly?	He was able to explain the content correctly.
	Is the teacher able to relate what he taught to real life examples?	Yes the teacher related what he taught to real life examples. Testing household substances for acidity and alkalinity.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions in this question.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	Appropriate chemicals were brought from home by learners. The teacher prepared test tubes, indicators, litmus paper, universal indicator and bromothymol blue.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	Indicators and testing household substances was part of the content for Senior Phase.
	Is the purpose of the experiment clearly stated?	This was not clearly stated but as the lessons progresses, the aims of the experiments emerged.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Were apparatus checked beforehand for functionality?	Some were brought from home by learners but the teacher prepared different indicators and test tubes.
	Was there a worksheet or guideline on what to observe?	The worksheet was written on the board for learners to copy in their workbooks.
	What was the source of the worksheet or guidelines?	The teacher's reference textbook was used to source the worksheet.
	Were learners clarified as to what to write on the worksheet?	The teacher explained that they should label the substances brought from home as acids, bases or neutrals as indicated in the worksheet.
	How was the practical work assessed or the experiment assessed?	They completed the worksheet.
	Did learners perform hands-on practical work?	The learners engaged in hands-on experiments where they tested household substances to find if they were acids or bases.
	Did the teacher conduct practical demonstration?	The teacher demonstrated to learners how they should test the household substances.
	If it was a demonstration, was it visible to all the learners? Explain how	Yes all the learners were able to see what the teacher was trying to show them in the demonstration he conducted. The learners were only 35 in the big classroom, where they could all see what the teacher was demonstrating from his table.
	What were the learners expected to do after seeing the demonstration?	In the lesson where demonstration was conducted, the learners were expected to test the other household substances given to their group after the demonstration.
	Were the learners assessed to find if they have learnt something from the demonstration?	Yes, the learners were shown the worksheets written on the board where they were required to write their observation as well as the conclusion of the experiment.
Pedagogical skills	Is there continuous assessment?	Oral questions were asked at the end of the lesson. A worksheet that was written on the board was another form of assessment.
	How is the classroom managed?	The classroom was well managed. Learners were well behaved whiles actively involved in testing the household substances.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Does the teacher link content to learners' previous knowledge and context?	Household substances brought were from the learners' home which is their familiar context. The linked this to the content of acids and bases. During the introduction of the lesson, learners were asked about indicators.
	How is the interaction of the teacher with learners?	The interaction of the teacher with the learners was good. Learners were free to interact with the teacher as they were conducting tests.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lesson. They were handling the apparatus and they were actively involved performing tests.
	Is there evidence of cooperative learning?	Learners were working together as groups conducting the tests whiles another was adding an indicator in the different solutions.
	Does the teacher use models/visual examples to explain science concepts?	The use of models was not evident in the lessons presented. Apparatus were part of the visuals used by the teacher to enhance learning.
	Are the various learning styles of learners accommodated in the lesson?	It did not come out clearly in this lesson.
	Is the teacher aware of learners' typical misconceptions?	This was not so evident in this lesson.
	Does the teacher use different strategies to teach? Explain how?	Group work and learners were required to complete the worksheet.
	Does the teacher ask learners questions that cater for the different cognitive levels?	Questions asked were 'What do you observe?' 'Is it an acid or a base?' after observing colour change when doing an experiment? What is an indicator?.
	Does the teacher ask learners questions that are linked to what the learners already know?	Yes that was evident in the beginning of the lesson where their understanding of indicators was asked.
	How much direct teaching does the teacher use?	Direct teaching was used minimally in this lesson. Learners mainly worked in groups testing solutions..

Elements of classroom practice to be observed	Question guiding observation	Comments
	How does the teacher use the discrepant event to clarify further for learners?	The use of discrepant event was not used in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	This lesson did not accommodate language skills. There was no reading as in lesson 1.
	Does the teacher code switch appropriately?	The teacher code switched appropriately by mentioning only few words in isiZulu. Like "niyezwa" [do you understand].
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	He was confident, moving from group to group.
	How is the enthusiasm of the teacher?	The teacher was enthusiastic.
	Does the teacher inspire the learners?	He inspired them by asking them to predict the results of the experiment before testing is conducted in each instance.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners were observing when the teacher was demonstrating and also conducted the testing.	Learners were touching the apparatus and keen to observe what will change.	Learners were well behaved and disciplined.	Learners were touching and using the resources under the supervision of the teacher.

Mr Wakithi lesson observation number 3

Classroom observation

Date of the observation	15 August 2013
School (Pseudonym)	Waiting Primary School
Name of the teacher (Pseudonym)	Mr Wakithi
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	8h00
Lesson topics	Classifying household substances

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	No content was presented in this lesson
	Is the content explained correctly?	No explanation happened in this lesson
	Is the teacher able to relate what he taught to real life examples?	Only a worksheet was written on the board for learners to copy and complete.
	Is the teacher able to respond to learners' questions correctly?	The teacher was supervising learners as they were classifying the different substances
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	Yes test tubes and indicators were prepared beforehand. Substances were brought from home by learners.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	Yes the experiment conducted was suitable for Senior Phase and the Natural Sciences curriculum.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Is the purpose of the experiment clearly stated?	Learners knew that they will be categorising household substances into acids, bases and neutrals.
	Were apparatus checked beforehand for functionality?	In this lesson substances were brought from home and test tubes and indicators were put on the table in the classroom.
	Was there a worksheet or guideline on what to observe?	The worksheet was written on the board for learners to copy and complete.
	What was the source of the worksheet or guidelines?	The source of the worksheet was the teacher's reference textbook.
	Were learners clarified as to what to write on the worksheet?	The teacher explained that learners were to write the name of the substance tested in column 1. Then in column 2, 3 and 4 they were required to tick whether that substance was acidic, basic or neutral.
	How was the practical work assessed or the experiment assessed?	The completed worksheet was a means of assessing the practical work.
	Did learners perform hands-on practical work?	Learners performed the hand-on practical work as they categorised the different substances.
	Did the teacher conduct practical demonstration?	In this lesson, no practical demonstration was conducted.
	If it was a demonstration, was it visible to all the learners? Explain how	There was no demonstration in this lesson.
	What were the learners expected to do after seeing the demonstration?	This is not applicable in this lesson.
	Were the learners assessed to find if they have learnt something from the demonstration?	This is not applicable in this lesson.
Pedagogical skills	Is there continuous assessment?	In this lesson the worksheet itself was a form of assessment.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	How is the classroom managed?	The classroom was well managed and learners worked in their own pace.
	Does the teacher link content to learners' previous knowledge and context?	The use of household substances.
	How is the interaction of the teacher with learners?	The interaction of the teacher with the learners was good. Learners were free to interact with the teacher. The teacher was supervising groups, looking at what they were writing in the worksheet.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lesson completing the worksheet. Also doing practical to verify the acidity and alkalinity of some substances.
	Is there evidence of cooperative learning?	Learners were working together testing and completing the worksheet where they were categorising the substances.
	Does the teacher use models/visual examples to explain science concepts?	Testing substances itself was visuals.
	Are the various learning styles of learners accommodated in the lesson?	It was not evident in this lesson as learners were completing the worksheet.
	Is the teacher aware of learners' typical misconceptions?	This was not evident in this lesson.
	Does the teacher use different strategies to teach? Explain how?	Learners worked in groups as they do experiment then work as individuals when completing the worksheet.
	Does the teacher ask learners questions that cater for the different cognitive levels?	This was not applicable in this lesson.
	How much direct teaching does the teacher use?	There was no direct teaching in this lesson only learner worked in groups.
	How does the teacher use the discrepant event to clarify further for learners?	This was not observed in this lesson as learners were completing the worksheet.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Language skills	Do the planned learning activities accommodate language skills?	This was not observed in this lesson.
	Does the teacher code switch appropriately?	As he was supervising the groups he was communicating with learners in isiZulu as well as in English.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	He was confident, mobile and supervising the different groups.
	How is the enthusiasm of the teacher?	The teacher was enthusiastic, friendly and moving around the class.
	Does the teacher inspire the learners?	Yes the teacher inspired the learners as he was moving from group to group he was asking them why this substance has been categorised as a base and that one an acid.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners participated in the completion of the worksheet.	Learners were motivated to get the correct answers.	Learners were well behaved and disciplined.	Learners were using the resources under the supervision of the teacher.

Mr Wakithi lesson observation number 4

Classroom observation

Date of the observation	20 August 2013
School (Pseudonym)	Waiting Primary School
Name of the teacher (Pseudonym)	Mr Wakithi
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	13h00
Lesson topics	Acid rain formation

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	Acid rain formation was presented correctly.
	Is the content explained correctly?	The teacher explained the formation of acid rain correctly.
	Is the teacher able to relate what he taught to real life examples?	Real life disadvantage of acid rain on plants and building was mentioned by the teacher in this lesson.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask any question.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	This was not a practical lesson.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	This was not a lesson where experiment was performed.
	Is the purpose of the experiment clearly stated?	This was not a lesson where experiment was performed.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Were apparatus checked beforehand for functionality?	This was not a lesson where experiment was performed.
	Was there a worksheet or guideline on what to observe?	This was not a lesson where experiment was performed.
	What was the source of the worksheet or guidelines?	This was not a lesson where experiment was performed.
	Were learners clarified as to what to write on the worksheet?	This was not a lesson where experiment was performed.
	How was the practical work assessed or the experiment assessed?	This was not a lesson where experiment was performed.
	Did learners perform hands-on practical work?	This was not a lesson where experiment was performed.
	Did the teacher conduct practical demonstration?	No practical demonstration conducted except citing examples of damage caused by the acid rain
	If it was a demonstration, was it visible to all the learners? Explain how	This was not a lesson where a demonstration was performed.
	What were the learners expected to do after seeing the demonstration?	This was not a lesson where a demonstration was performed.
	Were the learners assessed to find if they have learnt something from the demonstration?	This was not a lesson where a demonstration was performed.
Pedagogical skills	Is there continuous assessment?	Continuous assessment was observed from beginning to the end of the lesson. Questions like give three forms of water, what are the three phases of matter were asked.
	How is the classroom managed?	The classroom was well managed.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Does the teacher link content to learners' previous knowledge and context?	Yes, this was evident in the beginning of the lesson where the teacher revised in a question and answer style the three forms of water before teaching about acid rain formation. Learners were asked about the phases of matter learnt previously
	How is the interaction of the teacher with learners?	The interaction of the teacher with the learners was good. Learners were free to interact with the teacher responding to questions as the lesson unfolded.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lessons by answering questions.
	Is there evidence of cooperative learning?	Learners were listening and copying the chalkboard summary. There was no evidence of cooperative learning observed.
	Does the teacher use models/visual examples to explain science concepts?	No visuals and models were used in this lesson.
	Are the various learning styles of learners accommodated in the lesson?	The various learning styles of learners were not accommodated in the lesson since learners were listening, answering questions as the teacher was teaching.
	Is the teacher aware of learners' typical misconceptions?	The nature of the lesson did not reveal the awareness of the teacher of learners' typical misconceptions. He made drawings of clouds on the chalkboard as he was teaching about acid rain formation.
	Does the teacher use different strategies to teach? Explain how?	In this lesson only direct teaching was used.
	Does the teacher ask learners questions that cater for the different cognitive levels?	In this lesson only low order questions were asked. Questions asked were; what is an acid rain? What are the causes of acid rain? Name 4 damages caused by acid rain?
	How much direct teaching does the teacher use?	This lesson was only direct teaching.
	How does the teacher use the discrepant event to clarify further for learners?	This was not observed in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	Learners were given a chance to reason how acid rain affects animals.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Does the teacher code switch appropriately?	The teacher code switched appropriately. He did not explain in isiZulu throughout the lesson.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	He was confident in teaching science. he was not referring to any material as he was teaching.
	How is the enthusiasm of the teacher?	The teacher displayed enthusiasm throughout this lesson, he was relaxed.
	Does the teacher inspire the learners?	Yes the teacher inspired the learners through asking questions.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners actively participated in question and answer sessions when direct instruction was used.	Learners were answering questions as they were asked by the teacher.	Learners were well behaved and disciplined in all the lessons observed.	This lesson was not a practical lesson

Mr Wakithi's lesson observation number 5

Classroom observation

Date of the observation	21 August 2013
School (Pseudonym)	Waiting Primary School
Name of the teacher (Pseudonym)	Mr Wakithi
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	8h00
Lesson topics	Writing of the district assessment

In lesson 5 Mr Wakithi did not teach. He gave learners corrections of the previous district assessment. It seemed that assessment was previously given to learners to write at home. Now feedback was provided. Thereafter a new assessment was provided to learners. Mr Wakithi took them through the question and requested them to finish the new assessment at home.

Mr Wakithi's lesson observations number 6

Classroom observation

Date of the observation	22 August 2013
School (Pseudonym)	Waiting Primary School
Name of the teacher (Pseudonym)	Mr Wakithi
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	9h00
Lesson topics	Energy

Checklist for the lesson observation

Elements of classroom practice to be observed	Question guiding observation	Comments

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content was correctly presented. The lesson flow was fair; learners could follow the lesson as it was presented. He started by revising the definition of Energy then move to how plants and animals get energy.
	Is the content explained correctly?	He was able to explain the content correctly and in instances where learners struggled to follow he will code switch for learners to gain a better understanding of content.
	Is the teacher able to relate what he taught to real life examples?	Yes the teacher was able to relate what he taught to real life examples He made examples of cars requiring fuel to move and human beings food to work.
	Is the teacher able to respond to learners' questions correctly?	The teacher was able to respond to the learners questions well. One learner asked if non living organisms need energy to function. Then he gave the example of a car.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	This lesson was not a practical lesson, so this did not apply.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	This lesson was not a practical lesson, so this did not apply.
	Is the purpose of the experiment clearly stated?	This lesson was not a practical lesson, so this did not apply.
	Were apparatus checked beforehand for functionality?	This lesson was not a practical lesson, so this did not apply.
	Was there a worksheet or guideline on what to observe?	This lesson was not a practical lesson, so this did not apply.
	What was the source of the worksheet or guidelines?	This lesson was not a practical lesson, so this did not apply.
	Were learners clarified as to what to write on the worksheet?	This lesson was not a practical lesson, so there was no worksheet given to learners.
	How was the practical work assessed or the experiment assessed?	This lesson was not a practical lesson, so this did not apply.
	Did learners perform hands-on practical work?	This lesson was not a practical lesson, so this did not apply.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Did the teacher conduct practical demonstration?	He did not but only direct teaching was used.
	If it was a demonstration, was it visible to all the learners? Explain how	In this lesson there was no practical demonstration conducted.
	What were the learners expected to do after seeing the demonstration?	In this lesson there was no practical demonstration conducted.
	Were the learners assessed to find if they have learnt something from the demonstration?	In this lesson there was no practical demonstration conducted.
Pedagogical skills	Is there continuous assessment?	Throughout the lessons there were oral questions asked to assess the understanding of what the teacher was teaching.
	How is the classroom managed?	The classroom was well managed. Learners were well behaved whiles actively involved in the lesson by answering questions.
	Does the teacher link content to learners' previous knowledge and context?	Yes, time and again the learners were referred to their environment referring sun as the main source of energy for plants to make their own food.
	How is the interaction of the teacher with learners?	The interaction of the teacher with the learners was good. Learners were free to interact with the teacher responding to questions.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lesson answering question.
	Is there evidence of cooperative learning?	Learners did not work together in this lesson they were listening and answering questions.
	Does the teacher use models/visual examples to explain science concepts?	The use of models was not evident in this lesson except drawings done on the board illustrating energy flow from plants to animals.
	Are the various learning styles of learners accommodated in the lesson?	The various learning styles of learners were not accommodated by this lesson since only direct instruction was used.
	Is the teacher aware of learners' typical misconceptions?	Though this was not so evident in the lesson, the teacher made a chalkboard summary for learners to copy as notes at the end of the period.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Does the teacher use different strategies to teach? Explain how?	One teaching strategy was used, direct teaching.
	Does the teacher ask learners questions that cater for the different cognitive levels?	Questions asked were only low order questions. What do animals need to live? What is the main source of energy? What do plants need to grow? What do humans need to grow? Such questions were asked..
	How much direct teaching does the teacher use?	The whole lesson was direct teaching then questions answer was used too.
	How does the teacher use the discrepant event to clarify further for learners?	It was not observed in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	Language skill was accommodated in the lesson to a certain extent, learners were required to copy notes written on the board.
	Does the teacher code switch appropriately?	The teacher code switched appropriately as he was explaining to learners.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	He was confident, asking learners some questions. The confidence of the teacher was also observed when the teacher challenged learners to ask any question based on what he was teaching in the .lesson.
	How is the enthusiasm of the teacher?	The teacher was enthusiastic, energetic explaining energy flow.
	Does the teacher inspire the learners?	Yes the teacher inspired the learners by asking them questions.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners actively participated in question and answer sessions when direct instruction was used.	Learners have shown interest by answering questions as they were asked by the teacher.	Learners were well behaved and disciplined in all the lessons observed.	Learners were listening attentively as the teacher was explaining energy.

APPENDIX 8: MR WAKITHI DOCUMENT ANALYSIS

School (Pseudonym): Waiting Primary School

Date collected: August to September 2013
Importance of the document: To confirm the kind of activities given to learners and the frequency thereof.
Document analysis Guide 1: Learners' workbooks

CRITERIA	Comments
Activities based on practical work	✓ Activities based on practical work found; categorise household substances; separation of mixture; fractional distillation ✓ Not based on practical activities: complete sentences; most insects live on...; match column A and B; Explaining words; classifying plants; labelling plants.
Frequency of written work	✓ In January there were 4 written work, 2 in February, 2 in March, 8 in April, 7 in May, 1 in June, 6 in July and 8 in August.
Accuracy of feedback or corrections given to learners by the teacher;	✓ Corrections were found ✓ Feedback found was accurate
Activities that require high order thinking;	✓ explain the differences between asteroids and comets ✓ investigate acids and bases from home, ✓ describe the causes of an earthquake ✓ look at the picture then answer questions, ✓ discuss why the Sun is regarded as life giving in our Solar system
Evidence of various forms of assessment given to learners;	✓ Translation tasks; class tests; investigation and case study.

Document analysis Guide 2: Teacher documents and records (Work Schedule, lesson preparation and programme of assessment**)**

CRITERIA	Comments
Activities in teacher planning that involve practical work	✓ Worksheets-investigating the usefulness of tea in investigating acids and bases; separating mixtures; classifying substances as acids and bases; worksheet with a picture of fractional distillation where learners should respond to questions; ✓ Handouts with activities-explain how water and sand can be separated; what do we call this method of separating mixtures ;
Science content covered for the grade in the planning	✓ Content in lesson preparations in line with the work schedule for grade 7 ✓ Content found was on monocot and dicot plants; showing the structure of a sword fern and the different leave types; showing ecosystem; Linda's calendar of menstruation; structure of a volcano; asteroids and comets; heat radiation; energy, acids and bases.
Learners assessment records, planned for various learning styles	✓ Translation tasks, investigation, case study and class tests.
Recording sheets for the learner performance	✓ Mark lists with learner's marks and percentages.

APPENDIX 9: Interview transcript for Mr Mashangura

	Interview Questions	**Description of Code**	**Code**	**Researcher's comments**
Researcher	Do you believe that you have sufficient subject knowledge to teach the syllabus in Natural Sciences?			
Teacher	Yes	Teacher confidence Subject knowledge	TC SK	Though he did not specify at this stage the subject knowledge, he reflected confidence.
Researcher	Yes, can you give an example of subject knowledge in the syllabus that you struggle to teach?			
Teacher	Eh! I can say is Acids and base due to what? lack of lab at the school.	Subject knowledge Resource Needs	SK RN	He did not answer the question but lack of laboratory was indicated as a reason to struggle to teach acids and bases
Researcher	Do you believe that you have sufficient practical skills to do the prescribed experiments?			
Teacher	Yes	Teacher confidence Practical skills	TC PS	Though he did not expand after saying yes , he was confident that he has practical skills
Researcher	How often do you do experiments with learners?			
Teacher	Eh I control… by the context according to the strands you understand it means I was supposed to do it once a week due to the stands [strands].	Practical skills Teacher's attitude	PS TA	He understands that he needs to do experiments once a week, but his attitude was that there are other factors to be considered.
Researcher	Do you have enough apparatus to conduct experiments?			

	Interview Questions	Description of Code	Code	Researcher's comments
Teacher	Eh! Apparatus partially, partially they are not enough. Before I answer that question partially due to there is no safe place the way I told you that we are lacking. Before you want to do experiments it is time consuming.	Teacher's attitude Resource Needs	TA RN	The indication was collecting resources from different places was time consuming
Researcher	Are there enough apparatus to do experiments?			
Teacher	I said partially they are not enough. Because you will find that they are put in a cupboard they are not on one place, you suppose to come with them on time to put in class.	Resource Needs	RN	Probably there are few apparatus scattered in different rooms in the school.
Researcher	Do you sometimes use improvised materials to do experiments? Can you give examples?			
Teacher	Yes ..ha..example for doing something maybe I can tell children to come with apparatus from home which are familiar to them. Yes they have apparatus at home which are familiar. I can go round the school.	Practical skills Teacher's attitude Improvisation	PS TA IMP	It seems like some improvised materials is found from the environment of the school and others is brought by learners from home.
Researcher	How do you plan lessons?			
Teacher	Eh ….It is developed from a year long plan and the learning programmes by identifying the role…. And also it's developed by the individual teacher.	Pedagogical skills Teacher's attitude	PDS TA	He sounded confident and organised as he was saying that he uses learning programme then plan as an individual..
Researcher	Do you use maybe internet to plan and prepare for each lesson?			
Teacher	Eh..I sometimes go to the internet but I use a tool to develop these lesson plans. Eh and also sorry mam, when I do this apparatus….in Wits they support me and develop me they give a lesson development frame to do lesson preparations. Because it has all the activities needed in the lesson plan.	Pedagogical skills Outcomes of the ACE programme Teacher's attitude	PDS OAP TA	The institution where ACE was completed provided a frame with all the elements that are expected to be in each lesson.
Researcher	Wow ohkay I want to know how do you decide which learning activities to use in a lesson?			

	Interview Questions	**Description of Code**	**Code**	**Researcher's comments**
Teacher	Ohkay …learning activities teaching approach is very important.	Pedagogical skills. Teacher confidence	PDS TC	He did not answer the question directly but with confidence he said teaching approach was important.
Researcher	What do you do when learners are struggling to understand what you are teaching them?			
Teacher	I use the practical experiment and also maybe applying the, using the teaching aids like the teaching aids ,like pictures	Understanding learners Practical skills Pedagogical skills	UL PS PDS	He used different strategies to assist learners who are struggling
Researcher	Ohkay, How do you accommodate learners with different learning styles?			
Teacher	Eh learners with different learning styles…I provide pictures and repetition keys like ideas linking the concepts	Understanding learners Pedagogical skills	UL PDS	He seemed to understand how different learners learn science.
Researcher	How do you help learners to understand science when they have difficulty to understand the language?			
Teacher	I help them through the resources eh I have like practical experiments, models, pictures and also their environment.	Understanding learners Practical skills Pedagogical skills	UL PS PDS	He seemed to use various resources he can for learners to learn science.
Researcher	And then, what kinds of experiences do you think enables learners to learn science?			
Teacher	Maybe by touching and feeling, you understand, maybe they are doing experiment and find that these learners are not coping…maybe I allocate work to them if they can't get my style well in group work so that learning occurs can allow allocate work to them.	Understanding learners Teacher' s beliefs	UL TB	He believed in teaching learners using learner engagement.
Researcher	Now I want to know what you think the Department of Education wanted you to learn from the ACE programme?			

	Interview Questions	Description of Code	Code	Researcher's comments
Teacher	It to upgrade my qualification and also to have more knowledge of teaching…and also to have more knowledge in teaching and also to have more knowledge in teaching.	Outcomes of the ACE programme	OAP	He only refers to knowledge about teaching but does not elaborate.
Researcher	What do you think the University wanted you to learn from the ACE course?			
Teacher	To further my own professional deve deve…lopment and help me to meet the challenge of the teaching and learning	Outcomes of the ACE programme	OAP	He thinks they wanted him to be a better teacher.
Researcher	Alright, how did you think your classroom practice was expected to change after completing the ACE program?			
Teacher	Eh..through discipline in the class and also learners participation in class.	Outcomes of ACE programme	OAP	He thinks that discipline should improve and that learners should participate.
Researcher	Do you think your subject knowledge has improved?			
Teacher	Definitely!	Teacher's beliefs Teacher confidence Subject Knowledge	TB TA SK	He was convinced his subject knowledge has improved.
Researcher	Mention one science concepts you think you learnt in ACE			
Teacher	Yes..eh..oh science concepts…uhmm.. by doing experiment and by changing style of teaching…by doing experiments…investigation and also motivating learners to participate.	Teacher's beliefs Teacher's confidence Pedagogical skills	TB TC PDS	In his response he mentioned other things but no science concept learnt in ACE.
Researcher	If no, why do you think you did not learn anything from ACE?			
Teacher	Definitely (requested to explain) eh… science concepts…by doing experiments and by maybe eh…changing the style of teaching. And motivating the learners to do experiments. Teaching by doing experiments.	Teacher's beliefs Pedagogical skills Subject knowledge Practical skills	TB PDS SK PS	He could not mention science concepts learnt in ACE but emphasized doing experiments.

	Interview Questions	Description of Code	Code	Researcher's comments
Researcher	Can you tell me about something you were taught in ACE which you are practicing in class?			
Teacher	The role of learners under constructivism eh. There is an acting learner. The learner participates and understands in class. There is a social learner working in groups. There is a creative learner. The learners participate in class. I also learnt about theorist like …Vygotsky.	Teacher's beliefs Understanding learners Outcomes of the ACE programme	TB UL OAP	It looked like he learnt about the theory of constructivism from the ACE programme
Researcher	Ohkay, you say those theories helped you changed the classroom practice.			
Teacher	Yes yes.	Teacher's beliefs Teacher confidence	TB TC	He believed that learning theories assisted him to change his classroom practice.
Researcher	Did your learners' behaviour in class changed since you completed ACE?			
Teacher	Yes, they have changed.	Learner outcomes	LO	He understood that learners' behaviour has changed.
Researcher	How?			
Teacher	They want to concentrate……..in order to challenge the question asked in class and since they know in science we talk about true things, real things. You cannot say a child come from the ambulance … cannot say the child come from the river or aeroplane or ambulance. They have to understand that in reproduction the egg will meet the sperm cell.	Learner outcomes Understanding learners Teacher's belief	LO UL TB	He claims that the learners are motivated, inquisitive and want correct information.
Researcher	Do you think learners are now enjoying science when you teach now that you completed ACE?			
Teacher	Yes	Learner outcomes	LO	Though he did not elaborate he seemed to be certain.
Researcher	Why, explain why do you think they are enjoying? If no, what prevent them from enjoying?			
Teacher	Because science. In science…you play games when you are teaching them about planet earth.. they play games, they touch things, you can give learners the names of planets. They must mention the planets. They must know that planets that are near the sun. They play games, there is a lot of demonstration. They demonstrate and they touch things and feel things before they write formal or informal activities.	Teacher's beliefs Understanding learners Pedagogical skills	TB UL PDS	He understood learners learn using all their senses, playing and participating.

	Interview Questions	Description of Code	Code	Researcher's comments
Researcher	Did you enjoy the ACE programme?			
Teacher	Definitely I did enjoy it.	Teacher's confidence	TC	He was certain that he enjoyed the ACE programme.
		Teacher's attitude	TA	
Researcher	Can you name a specific concept that you enjoyed about ACE programme?			
Teacher	Planning because you cannot go to the class without planning you must be thoroughly prepared and also the way of teaching and assessing learners. I have gained a lot from the ACE programme.	Teacher's belief	TB	He named planning as well as the way of teaching and assessing as a concept he has enjoyed to learn from the ACE programme.
		Outcomes of ACE programme	OAP	
		Teacher's attitude	TA	
		Pedagogical skills	PDS	
Researcher	Do you enjoy teaching science more than before you completed the ACE programme?			
Teacher	No, before you said before going to ACE now I was not have enough skills.	Teacher's beliefs	TB	He is defensive. He does not want to suggest that before the ACE he did "not have enough skills"
		Outcomes of ACE programme	OAP	
Researcher	Can you mention a specific thing you now enjoy in teaching science?			
Teacher	Investigation, I enjoy doing investigation.	Teacher's beliefs	TB	He was sure that he enjoys investigation
		Teacher confidence	TC	
		Teacher's attitude	TA	
Researcher	Can you mention a specific thing you enjoy in teaching science?			
Teacher	Iya (yes)…investigation and doing experiment I enjoyed them. Because this one even learners who do not cope understand, to explain further the investigation.	Teacher's beliefs	TB	He was kind of consistent, since this question was repeated in trying to get more information.
		Pedagogical skills	PDS	
		Practical skills	PS	
Researcher	Do you have more confident now in teaching science?			
Teacher	Yes	Teacher confidence	TC	

	Interview Questions	Description of Code	Code	Researcher's comments
Researcher	How confident are you to share what you were taught in ACE with other teachers in your cluster?			
Teacher	In the cluster we plan together as a cluster, we set common paper together setting exams and tests together. I enjoy it I was a cluster leader first but now I had lot of job, and also a leader of some kind and ehh……	Teacher's attitude Collaboration Teacher confidence	TA C TC	He is confident and enjoys collaboration in the cluster but he did so before ACE also.
Researcher	Do you have a position in the cluster?			He earlier on indicated that he left the leadership in the cluster due to other commitment in the school.
Teacher	I am a leader for rugby in the school, I am a coach in sport, you can see it is too much.	Teacher confidence Teacher's attitude	TC TA	
Researcher	Can you explain the effect of the learners' responses on your new classroom practice?			
Teacher	Eh repeat your question. Ok let's repeat your question.			He did not understand the question the first time I asked him.
Researcher	What effect do your learners' responses have on your classroom practice?			
Teacher	Ok…the participation of the learners is high you understand and also when you give them the work you have no stress, because they will do it, you understand and also when you give them work. They will indicate when they need assistance.	Learners' outcomes Teacher's attitude	LO TA	He indicates positive outcomes from learners and this reduces his stress.
Researcher	Thank you my second last question, would you be willing to share what you learnt in ACE in the cluster meeting?			
Teacher	Yes, yes ja.	Teacher confidence Collaboration Teacher's attitude	TC C TA	He was confident that he would share with teachers in the cluster.
Researcher	Can you explain how the ACE NS programme has changed the way you believe and view yourself as a science teacher?			
Teacher	I gain experience on how to plan. Assess investigation, and also form of assessment, also doing rubrics	Teacher's beliefs	TB	He managed to list

	Interview Questions	Description of Code	Code	Researcher's comments
		Outcomes of the ACE programme	OAP	planning and assessment using rubrics as part of what he benefitted from the ACE programme.
Researcher	Thank you my last question, Is there any other thing you want to share with me about the ACE programme that you did?			
Teacher	Eh…the thing which I can say first of all I would like to thank our government for giving us this opportunity and I say in future our government must keep on developing us with another mechanism which they can do.	Teacher's beliefs Teacher's attitude Outcomes of the ACE programme	TB TA OAP	He was willing to be enrolled on another programme and I assumed that ACE programme has developed him.
Researcher	Thank you so much we have come to an end of the interview.			

Appendix 10: MR MASHANGURA LESSON OBSERVATIONS TRANSCRIPT

Mr Mashangura lesson observations number 1
Classroom observation

Date of the observation	13 August 2013
School (Pseudonym)	Mashaning Primary School
Name of the teacher (Pseudonym)	Mr Mashangura
Subject	Natural Sciences
Grade	Grade 7
Number of learners	41
Period number and time	8h00
Lesson topic	Mixtures

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on mixtures was correctly presented to learners. Notes written on the board were read.
	Is the content explained correctly?	The content was correctly explained. The teacher ensured that learners understood the content before allowing them to do experiments. Terms explained were pure substance, solution, solute, mixture and solvent.
	Is the teacher able to relate what he taught to real life examples?	Yes the teacher related what he taught to real life examples, learners were requested to bring ingredients for real mixtures from home.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions in this lesson.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	The learners brought the household substances from home well in advance for one lesson on mixtures. The other apparatus were prepared in advanced and stored in the boot of the teacher's car.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	Yes the experiment conducted was suitable for Senior Phase as reflected in the work schedule that the teacher has received from the district office. The experiments conducted were relevant to the curriculum according to the RNCS.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Is the purpose of the experiment clearly stated?	The purpose of the experiment conducted was clarified well in advanced as making mixtures of their choice.
	Were apparatus checked beforehand for functionality?	This was not done as learners brought these from home.
	Was there a worksheet or guideline on what to observe?	The worksheet in this lesson was part of the notes the teacher wrote on the board. Learners knew exactly what they were supposed to do. At the end of the lesson learners were requested to answer questions.
	What was the source of the worksheet or guidelines?	The worksheet was taken from the textbook that the teacher is using as the resources for reference.
	Were learners clarified as to what to write on the worksheet?	Yes they were clarified on what to write on the worksheet.
	How was the practical work assessed or the experiment assessed?	The practical work was assessed through the question and answer sessions orally. Also, the work sheet was another means of assessing the practical work.
	Did learners perform hands-on practical work?	Learners made mixtures of their choice.
	Did the teacher conduct practical demonstration?	He demonstrated the separation of oil and water.
	If it was a demonstration, was it visible to all the learners? Explain how	All the learners saw what the teacher was demonstrating as well since this was a small classroom with 40 learners. The teacher had an advantage of height as well.
	What were the learners expected to do after seeing the demonstration?	The learners were expected to describe the separation method the teacher had use in the demonstration.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	The demonstration activity was not assessed.
Pedagogical skills	Is there continuous assessment?	Oral question and answer to assess their understanding was done continuously as the lesson progresses.
	How is the classroom managed?	Well managed and the teacher was in control even when the learners were presenting their mixtures

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Does the teacher link content to learners' previous knowledge and context?	Learners were taught from what was familiar to them. Mixtures of foods from home. He did by reminding learners what they learnt in the previous lesson. The teacher started by asking the learners questions about what was learnt in the previous lesson.
	How is the interaction of the teacher with learners?	The interaction was fine because learners followed the instruction well. There was cooperation.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lesson by answering questions and by presenting their mixtures for the whole class to see.
	Is there evidence of cooperative learning?	Learners worked in groups in making mixtures and one member of the group presented on behalf of the group.
	Does the teacher use models/visual examples to explain science concepts?	Making mixtures and demonstrating the separation of oil from water.
	Are the various learning styles of learners accommodated in the lesson?	The various learning styles of learners were accommodated in this lesson- learners were requested to present their mixtures for the whole class to see. The teacher took learners through notes written on the board allowing the learners to read notes as he explains,
	Is the teacher aware of learners' typical misconceptions?	This was not observed in this lesson.
	Does the teacher use different strategies to teach? Explain how?	Question and answer, group work, teaching and reading notes on the chalkboard was observed.
	Does the teacher ask learners questions that cater for the different cognitive levels?	The teacher asked learners questions that cater for the different cognitive levels for an example the teacher asked learners to "what is a pure substance", "what is a solution", "what is a solute", "describe a mixture", "what is a solvent".
	How much direct teaching does the teacher use?	Direct teaching was done reasonably well. A variety of teaching methods were used. Group work was used too.
	How does the teacher use the discrepant event to clarify further for learners?	This was not evident in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	The teacher allowed the learners to read notes from the chalkboard. Whenever the learners were not pronouncing the word correctly the teacher corrected them.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Does the teacher code switched appropriately	The teacher did not code switched he explained in English until the learners understood what they are taught.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher was very confident and competent to teach the content on mixtures.
	How is the enthusiasm of the teacher?	The teacher was enthusiastic and he clarified further for learners.
	Does the teacher inspire the learners?	Yes through oral questions and answers and by giving them questions to answer in their workbooks.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners were actively involved in all the lessons. Presentation of findings of the experiments in front of the whole class was done.	Answering questions, presenting their findings, actively engaged in each lesson indicated that they were interested in the lessons presented.	Well behaved and disciplined.	Resources were well utilized by learners under the supervision of the teacher.

Mr Mashangura's lesson observations number 2
Classroom observation

Date of the observation	14 August 2013
School (Pseudonym)	Mashaning Primary School
Name of the teacher (Pseudonym)	Mr Mashangura
Subject	Natural Sciences
Grade	Grade 7
Number of learners	41
Period number and time	12h00
Lesson topic	Chromatography-reading notes

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content was correctly presented to learners and notes written on the board were read.
	Is the content explained correctly?	The content was correctly explained as learners read the notes on the board.
	Is the teacher able to relate what he taught to real life examples?	The example of mixtures made..
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask any question in this lesson.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	The practical on chromatography was conducted in the next lesson, only notes were read in this lesson.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	No experiment done in this lesson
	Is the purpose of the experiment clearly stated?	No experiment done in this lesson
	Were apparatus checked beforehand for functionality?	No experiment done in this lesson

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Was there a worksheet or guideline on what to observe?	No experiment done in this lesson
	What was the source of the worksheet or guidelines?	No experiment done in this lesson
	Were learners clarified as to what to write on the worksheet?	No experiment done in this lesson
	How was the practical work assessed or the experiment assessed?	No experiment done in this lesson
	Did learners perform hands-on practical work?	No experiment done in this lesson
	Did the teacher conduct practical demonstration?	No experiment done in this lesson
	If it was a demonstration, was it visible to all the learners? Explain how	It was not a demonstration lesson but explanation of notes.
	What were the learners expected to do after seeing the demonstration?	It was not a demonstration lesson.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	The practical on chromatography was to be conducted in the next lesson, only notes were read in this lesson.
Pedagogical skills	Is there continuous assessment?	The practical on chromatography was to be conducted in the next lesson, only notes were read.
	How is the classroom managed?	Well managed and the teacher was in control. Learners presented their findings.
	Does the teacher link content to learners' previous knowledge and context?	This lesson started with the revision of the previous lesson where learners presented the mixtures made previously. In the beginning of the lesson where the teacher allowed the learners to share how they got their mixture made the previous day.
	How is the interaction of the teacher with learners?	The interaction was fine because learners were listening as notes were explained.
	How is learner participation, are they actively involved?	Learners were actively involved in the lesson reading notes.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Is there evidence of cooperative learning?	There was no evidence of cooperative learning observed in this lesson.
	Does the teacher use models/visual examples to explain science concepts?	The lesson itself was visual, learners presented mixtures made in the previous lesson before the reading of the notes.
	Are the various learning styles of learners accommodated in the lesson?	The various learning styles of learners were accommodated. Notes on chromatography were written on the board and learners read through.
	Is the teacher aware of learners' typical misconceptions?	It was not evident in this lesson.
	Does the teacher use different strategies to teach? Explain how?	Question and answer as reading of notes progressed.
	Does the teacher ask learners questions that cater for the different cognitive levels?	The questions asked by the teacher were 'explain what you have mixed', naming the different types of methods to separate mixtures.
	How much direct teaching does the teacher use?	There was limited direct teaching in the lesson; learners read notes as the teacher explained.
	How does the teacher use the discrepant event to clarify further for learners?	This was not evident in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	The group leader presented on behalf of the group the previous day mixture and the teacher allowed the learners to read notes from the chalkboard.
	Does the teacher code switch appropriately	The teacher did not code switch he explained in LoLT which is English throughout the lesson.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher was confident as he was explaining the notes on chromatography.
	How is the enthusiasm of the teacher?	He was enthusiastic and excited as he was coaching how the experiment on chromatography should be done.
	Does the teacher inspire the learners?	Learners were inspired and they were willing to present their findings.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Presentation of findings of the experiments in front of the whole class.	Answering questions, presenting their findings, actively engaged in each lesson.	Well behaved.	Resources handled as they present their mixtures

Mr Mashangura's lesson observation number 3

Classroom observation

Date of the observation	15 August 2013
School (Pseudonym)	Mashaning Primary School
Name of the teacher (Pseudonym)	Mr Mashangura
Subject	Natural Sciences
Grade	Grade 7
Number of learners	41
Period number and time	13h30
Lesson topic	Methods of separating mixtures

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on separation on mixtures was correctly presented to learners. Decanting and sieving were presented as methods of separating mixtures.
	Is the content explained correctly?	The content was accurately explained.
	Is the teacher able to relate what he taught to real life examples?	Sieving and decanting were related to real life.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask any question in this lesson.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	Yes appropriate apparatus were selected and prepared beforehand. Each and every group was supplied by water, filter paper and ink for the experiment on chromatography.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	Yes the experiment conducted was suitable for Senior Phase as reflected in the work schedule that the teacher has received from the district office. The experiments conducted were relevant to the curriculum as reflected in chapter 5 of RNCS.
	Is the purpose of the experiment clearly stated?	The purpose of the experiment conducted was clarified as separation of mixtures using decanting, sieving and chromatography.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Were apparatus checked beforehand for functionality?	The teacher seemed to have checked the apparatus beforehand. Sieve, sand, filter paper, ink and water.
	Was there a worksheet or guideline on what to observe?	The worksheet in the lesson was part of the notes on chromatography given to learners. There was no worksheet for sieving and decanting methods. .
	What was the source of the worksheet or guidelines?	The worksheet was taken from the textbook that the teacher is using as the resource for reference.
	Were learners clarified as to what to write on the worksheet?	They were told which questions to answer. Each learner was expected to answer as an individual in the workbook.
	How was the practical work assessed or the experiment assessed?	The worksheet was a means of assessing the understanding of the learner on the experiment conducted.
	Did learners perform hands-on practical work?	Learners performed hand-on experiment on decanting, sieving and chromatography in this lesson.
	Did the teacher conduct practical demonstration?	The teacher did not demonstrate but allowed learners to go through all the steps in conducting the experiment on chromatography.
	If it was a demonstration, was it visible to all the learners? Explain how	It was not a demonstration lesson.
	What were the learners expected to do after seeing the demonstration?	It was not a demonstration lesson.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	Learners presented their finding to the whole class showing how the ink has separated.
Pedagogical skills	Is there continuous assessment?	In this lesson learners conducted the experiment on chromatography following the steps written on the board.
	How is the classroom managed?	Well managed and the teacher was in control. Learners presented their findings in front of the whole class.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Does the teacher link content to learners' previous knowledge and context?	This lesson started with the revision of the previous lesson where learners presented the mixtures made previously. Then decanting and sieving were done before focusing on chromatography. In the beginning of the lesson where the teacher asked the learners how they can separate their mixture made the previous day.
	How is the interaction of the teacher with learners?	The interaction was fine because learners were following the instructions and cooperated with the teacher.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lesson by answering questions and by handling apparatus and chemicals, presented their filter paper showing how the ink has separated.
	Is there evidence of cooperative learning?	Learners cooperated with the leader of the group on conducting experiments.
	Does the teacher use models/visual examples to explain science concepts?	The lesson itself was visual, learners performing the experiment, decanting, sieving and chromatography.
	Are the various learning styles of learners accommodated in the lesson?	The various learning styles of learners were accommodated because learners read the notes, presented how they mixed and how to separate their mixtures.
	Is the teacher aware of learners' typical misconceptions?	It was evident in this lesson.
	Does the teacher use different strategies to teach? Explain how?	Question and answer, group work when doing experiment, learners reading notes from the chalkboard.
	Does the teacher ask learners questions that cater for the different cognitive levels?	The teacher asked learners questions "describe to the class how ink was separated".
	How much direct teaching does the teacher use?	There was limited direct teaching in this lesson mainly learners were presenting and conducting experiments.
	How does the teacher use the discrepant event to clarify further for learners?	This was not observed in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	The teacher allowed the learners to read notes from the chalkboard.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Does the teacher code appropriately	Mr Mashangura did not code switch he explained in English for learners to understand.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher was confident.
	How is the enthusiasm of the teacher?	He was enthusiastic, coaching learners how chromatography should be done.
	Does the teacher inspire the learners?	Learners were inspired and they were willing to conduct the experiment then present their findings.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners were actively involved in all the lessons. They were engaged in doing the practical work; presentation of findings of the experiments in front of the whole class.	Presenting their findings, actively engaged in each lesson indicated that they were interested in the lessons presented.	Well behaved.	Resources were well utilized by learners under the supervision of the teacher.

Mr Mashangura's lesson observation number 4
Classroom observation

Date of the observation	20 August 2013
School (Pseudonym)	Mashaning Primary School
Name of the teacher (Pseudonym)	Mr Mashangura
Subject	Natural Sciences
Grade	Grade 7
Number of learners	41
Period number and time	8h00
Lesson topic	Recycling

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on recycling was correctly presented to learners. Oral questions were asked to introduce the lesson.
	Is the content explained correctly?	Recycling was explained correctly.
	Is the teacher able to relate what he taught to real life examples?	The teacher related what he taught to real life examples. The separation of waste was related to the business of recycling in real life situation.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask question in this lesson.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	Two rubbish bins with waste were taken from the school yard and utilized for the purpose of the lesson.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	Recycling is reflected in the Senior phase curriculum statement
	Is the purpose of the experiment clearly stated?	The teacher clarified that learners were going outside to separate waste.
	Were apparatus checked beforehand for functionality?	This was not applicable for this lesson as only rubbish bins and waste were used.
	Was there a worksheet or guideline on what to observe?	Learners collected and separated waste but no criteria and worksheet was provided.

Elements of classroom practice to be observed	Question guiding observation	Comments
	What was the source of the worksheet or guidelines?	Orally done
	Were learners clarified as to what to write on the worksheet?	There was no worksheet provided
	How was the practical work assessed or the experiment assessed?	The practical was not formally assessed but orally learners were asked to explain how they separated waste.
	Did learners perform hands-on practical work?	They collected and separated the waste.
	Did the teacher conduct practical demonstration?	There was no demonstration conducted in this lesson.
	If it was a demonstration, was it visible to all the learners? Explain how	There was no demonstration conducted in this lesson.
	What were the learners expected to do after seeing the demonstration?	There was no demonstration conducted in this lesson.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	Orally learners were required to explain the criteria they used to separate waste.
Pedagogical skills	Is there continuous assessment?	Oral question and answer to assess their understanding of recycling was done at the end of the lesson.
	How is the classroom managed?	It was outdoor and it was well handled.
	Does the teacher link content to learners' previous knowledge and context?	Yes waste was taken as a mixture to be separated. The teacher related this lesson to the lesson on separation of mixtures.
	How is the interaction of the teacher with learners?	The interaction was fine because learners were following the instruction and they were disciplined.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lesson by collecting waste and separated it.
	Is there evidence of cooperative learning?	Learners worked together collected and separated waste.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Does the teacher use models/visual examples to explain science concepts?	The lesson itself was visual, learners collected and separated waste according to their own criteria.
	Are the various learning styles of learners accommodated in the lesson?	Visual learners benefitted most from this lesson.
	Is the teacher aware of learners' typical misconceptions?	That was not visible in this lesson
	Does the teacher use different strategies to teach? Explain how?	Yes question and answer and working in group was used in this lesson.
	Does the teacher ask learners questions that cater for the different cognitive levels?	In this lesson question asked was "what is recycling"? "What are uses of recycling"?
	How much direct teaching does the teacher use?	There was limited direct teaching in this lesson, it happened when the teacher was introducing the lesson and when he was concluding the lesson.
	How does the teacher use the discrepant event to clarify further for learners?	It was not evident in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	There was no reading of notes in this lesson.
	Does the teacher code switched appropriately	The teacher did not code switch he was communicating in English.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher was confident in teaching recycle and he facilitated it interestingly.
	How is the enthusiasm of the teacher?	The teacher was willing to explain more and clarify further for learners.
	Does the teacher inspire the learners?	Through oral questions learners were inspired.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners were actively involved in the lesson by collecting, sorting waste and presenting criteria used to sort waste.	Presenting their findings indicated that they were interested in the lesson conducted outdoor.	Well behaved though it was an outdoor lesson.	Resources were well utilized.

Mr Mashangura's lesson observations number 5
Classroom observation

Date of the observation	21 August 2013
School (Pseudonym)	Mashaning Primary School
Name of the teacher (Pseudonym)	Mr Mashangura
Subject	Natural Sciences
Grade	Grade 7
Number of learners	41
Period number and time	9h00
Lesson topic	Force

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on the effects of force was correctly presented to learners. Notes written on the board ensured that the teacher present the content in a sequence.
	Is the content explained correctly?	The content was accurately explained, the teacher decided to explain the lesson twice before allowing the learners to do simulations.
	Is the teacher able to relate what he taught to real life examples?	The teacher related what he taught to real life examples by referring to effects of force in the environment. He cited the example of car accidents.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask question in this lesson.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	This was not an experiment; the teacher used the classroom and learners to demonstrate the effect of force.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	The lesson was not an experiment but simulations based on the effects of force.
	Is the purpose of the experiment clearly stated?	Learners did not conduct experiment in this lesson.
	Were apparatus checked beforehand for functionality?	Learners did not conduct experiment in this lesson.
	Was there a worksheet or guideline on what to observe?	Learners did not conduct experiment in this lesson.

	What was the source of the worksheet or guidelines?	A handout with questions on the effect of force was given to learners.
	Were learners clarified as to what to write on the worksheet?	The handout was clarified to learners
	How was the practical work assessed or the experiment assessed?	The handout gives to all learners to respond by writing individually in their workbooks.
	Did learners perform hands-on practical work?	No some were used by the teacher in simulating the effects of force.
	Did the teacher conduct practical demonstration?	He demonstrated the effects of force by simulation.
	If it was a demonstration, was it visible to all the learners? Explain how	All the learners were able to see what the teacher was demonstrating. Learners could see from the back what the teacher was demonstrating in front of the class.
	What were the learners expected to do after seeing the demonstration?	Respond to questions on the effects of force.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	A handout given at the end of the lesson was an assessment of what was learnt.
Pedagogical skills	Is there continuous assessment?	Oral questions on the 7 effects of force were asked to assess the learners' understanding;
	How is the classroom managed?	Well managed and the teacher was in control.
	Does the teacher link content to learners' previous knowledge and context?	The lesson was linked with the forces existing between magnets. Understanding the concept on force.
	How is the interaction of the teacher with learners?	The interaction was good. The learners used for simulation on the effects of force cooperated well.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lesson.
	Is there evidence of cooperative learning?	This was not observed in this lesson.

	Does the teacher use models/visual examples to explain science concepts?	Simulations were used in this lesson for learners to understand the effects of force.
	Are the various learning styles of learners accommodated in the lesson?	Learners who learn by seeing benefitted from the simulation on the effect of force. A handout given with pictures on the effects of force to be translated benefitted the group of learners who are pictorial.
	Is the teacher aware of learners' typical misconceptions?	This was not evident in this lesson.
	Does the teacher use different strategies to teach? Explain how?	Yes question and answer and writing on the chalkboard as he was doing the simulations.
	Does the teacher ask learners questions that cater for the different cognitive levels?	Learners were asked to define force and describe the effects of force.
	How much direct teaching does the teacher use?	Direct teaching was done reasonably well in this lesson and simulations on the effects of force dominated the lesson.
	How does the teacher use the discrepant event to clarify further for learners?	This was not observed in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	Whenever the learners pronounced the word incorrectly the teacher corrected them immediately.
	Does the teacher code appropriately	The teacher did not code switch he explained in English until the learners understood what they are taught.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher was confident as he was doing the simulations.
	How is the enthusiasm of the teacher?	The teacher was willing to explain more and clarify further for learners understand the effects of force..
	Does the teacher inspire the learners?	Through oral questions and answers.

Description of Learners' behaviour			
Learners' active participation in	**Motivation and interest in the**	**Learner behaviour in the class**	**Use of resources or apparatus by**

the lesson	**lesson**		**learners**
Learners were actively involved in the lesson.	Answering questions and listening attentively indicated that they were interested in the lesson presented.	Well behaved despite the fact that they were not all involved in the simulation	Some participated in the simulations.

Mr Mashangura's lesson observations number 6
Classroom observation

Date of the observation	02 September 2013
School (Pseudonym)	Mashaning Primary School
Name of the teacher (Pseudonym)	Mr Mashangura
Subject	Natural Sciences
Grade	Grade 7
Number of learners	41
Period number and time	8h00
Lesson topic	Electricity

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on electricity and electrical circuits was correctly presented to learners using pictures and sketches of electrical circuits. .
	Is the content explained correctly?	The content was accurately explained
	Is the teacher able to relate what he taught to real life examples?	Real life example was given when the teacher spoke about the series and parallel circuits indicating the advantages of series and parallel connection in real life..
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions in this lesson.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	No experiment was conducted in this lesson.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	No experiment was conducted in this lesson.
	Is the purpose of the experiment clearly stated?	No experiment was conducted in this lesson.
	Were apparatus checked beforehand for functionality?	No experiment was conducted in this lesson.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Was there a worksheet or guideline on what to observe?	No experiment was conducted in this lesson.
	What was the source of the worksheet or guidelines?	No experiment was conducted in this lesson.
	Were learners clarified as to what to write on the worksheet?	The learners were given a handout that was assessing what was taught.
	How was the practical work assessed or the experiment assessed?	No experiment was conducted in this lesson. The lesson was assessed by giving learners a handout with task to do at home.
	Did learners perform hands-on practical work?	No
	Did the teacher conduct practical demonstration?	There was no practical demonstration conducted but the teachers made illustration and sketches of electrical circuits.
	If it was a demonstration, was it visible to all the learners? Explain how	No demonstration was conducted in this lesson.
	What were the learners expected to do after seeing the demonstration?	No demonstration was conducted in this lesson.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	No demonstration was conducted in the lesson, but they were assessed on what was learnt.
Pedagogical skills	Is there continuous assessment?	Oral question were asked on what was learnt previously on attraction and repulsive forces. In the beginning of the lesson learners were requested to name electrical appliances they know. Homework was given for learners to draw different circuit diagram.
	How is the classroom managed?	Well managed and the teacher was in control. .
	Does the teacher link content to learners' previous knowledge and context?	Yes this was evident in this lesson where the teacher kept on referring to what learners learnt about force and electrical appliances that they use at home.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	How is the interaction of the teacher with learners?	The interaction was fine because learners were relaxed and responding to questions.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lesson by answering questions as posed by the teacher.
	Is there evidence of cooperative learning?	In this lesson it was not observed.
	Does the teacher use models/visual examples to explain science concepts?	The teacher used circuit diagrams and pictures to illustrate the different electrical circuits.
	Are the various learning styles of learners accommodated in the lesson?	Yes the various learning styles of learners were accommodated in the lessons. Electrical circuits and pictures were given and from them circuit diagrams were drawn. The teacher explained what will happen as more components are added.
	Is the teacher aware of learners' typical misconceptions?	The teacher was aware of learners' typical misconceptions. He used pictures and circuit diagram to illustrate and explain electrical circuits.
	Does the teacher use different strategies to teach? Explain how?	In this lesson direct teaching was used and the chalkboard summary developed as the lesson progress.
	Does the teacher ask learners questions that cater for the different cognitive levels?	Learners were asked to: give examples of electrical appliance, draw circuit diagrams corresponding to the given pictures.
	Does the teacher ask learners questions that are linked to what the learners already know?	This was evident in the beginning of the lesson where the teacher started by asking the learners questions about what was learnt in the previous lesson.
	How much direct teaching does the teacher use?	Direct teaching was done reasonably well in this lesson. Drawings were made on the board corresponding to some pictures.
	How does the teacher address the typical misconception of learners?	The teacher addressed the misconception of learners by making drawing of circuit diagrams on the chalkboard.
	How does the teacher use the discrepant event to clarify further for learners?	This was not observed in this lesson.

Elements of classroom practice to be observed	Question guiding observation	Comments
Language skills	Do the planned learning activities accommodate language skills?	Learners were listening in the most part of this lesson as the teacher was explaining through circuit diagram and pictures.
	Does the teacher code switch appropriately	The teacher did not code switch he explained in English until the learners understood what they are taught.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher was very confident and competent to teach electrical circuits and made circuit diagrams of parallel and series circuits.
	How is the enthusiasm of the teacher?	The teacher was enthusiastic and passionate about the topic.
	Does the teacher inspire the learners?	Yes through oral questions and by giving learners questions to answer in their workbooks.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners were actively involved. They were engaged in question and answer sessions as the whole class.	Answering questions indicated that learners were interested in the lesson presented.	Well behaved and actively listening.	This was not a practical lesson.

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APPENDIX 11: MR MASHANGURA DOCUMENT ANALYSIS

School (Pseudonym): Mashaning Primary School
Date collected: August to September 2013
Importance of the document: To see the kind of activities given to learners and the frequency thereof.
Document analysis Guide 1: Learners' workbooks

CRITERIA	Comments
Activities based on practical work	✓ Activities based on practical work were: -making a model of a volcano; making mixtures; separating mixtures; recycling waste and investigate animals in the school yard. the rest were not based on practical activities like classify the following animals, complete the following sentences; study the diagram then answer the following questions.
Frequency of written work	✓ In January learners' books reflected 5 written work and in February 4, in March 4, in April 4, May 8, June 4, July 3, August 7.
Accuracy of feedback or corrections given to learners by the teacher;	✓ Corrections were reflected in the learners' books ✓ No mistakes were found.
Activities that require higher order thinking;	✓ Activities: If you have a mixture of rice and beans, explain how you will separate; Name the method you will use; study pictures below and answer following questions; look at the picture and describe
Evidence of various forms of assessment given to learners;	✓ Translation tasks; investigations; tests and assignments.

Document analysis Guide 2: Teacher documents and records (Work Schedule, lesson preparation and programme of assessment**)**

CRITERIA	Comments
Activities in teacher planning that involve practical work	✓ Handouts on different content-forces, classification of animals, mixtures; effects of force; recycling material; volcanic eruptions ✓ Worksheets for different content- separating oil and water; rice and beans; chromatography
Science content covered for the grade in the planning	✓ work schedule with ticks for content already covered ✓ Lesson plans reflected content in the work schedule ✓ Lesson plans in the template with learning outcomes and assessment standards. ✓ Hand outs of activities
Learners assessment records, planned for various learning styles	✓ Programme of assessment with dates for assessment ✓ Investigation, test, translation tasks and assignment
Recording sheets for the learner performance	mark list with learners' marks and percentages

APPENDIX 12: INTERVIEW TRANSCRIPT FOR MR ZULU

	Interview Questions	Description of code	Code	Researcher's comment
Researcher	Do you believe that you have sufficient subject knowledge to teach Natural Sciences?			
Teacher	Yes yes yes I do have ma'm.	Teacher's attitude Teacher confidence Subject knowledge	TA TC SK	He displayed over-confidence when he responded to this question with the 3 yeses.
Researcher	Can you give an example of subject knowledge in the syllabus?[the teacher was quiet] Maybe if there is something interesting or a topic that you are struggling to teach?			
Teacher	Aih, there is no there is no-there is no problem as far as everything is concern in science, the only challenge that I have is experiment because here at our school we don't have a laboratory, otherwise the rest eh…eh	Resource needs Teacher confidence	RC TC	No subject knowledge was given except the challenge of experiments because of the lack of the laboratory.
Researcher	Do you believe that you have sufficient practical skills to do the prescribed experiments?			
Teacher	No, as I have explained that we do not have a laboratory and also the apparatus to perform those experiments.	Practical skills Resource needs	PS RN	He mentioned again the lack of a laboratory without mentioning practical skills.
Researcher	Plus or minus, how often do you do experiments with learners?			
Teacher	I suppose to do it once a term, maybe per quarter one experiment because we have 4 different strands.	Practical skills Teacher's attitude	PS TA	The frequency of doing experiments

	Interview Questions	Description of code	Code	Researcher's comment
				sounded little.
Researcher	Do you have enough apparatus to conduct experiments, If no, what is needed?			
Teacher	No, no, the whole science kits, if they bought the whole science kits because it has all the apparatus inside.	Resource Needs	RN	His view was that they need science kits because they do not have a laboratory.
Researcher	Do you sometimes use improvised materials to do experiments? If yes, can you give an example			
Teacher	I do improvise.	Improvisation	IMP	Though he indicated that he improvise he did not give an example.
Researcher	How do you plan lessons?			
Teacher	I plan my lessons, eh, before-before I teach maybe two days before I teach, sometimes a day.	Pedagogical skills Teacher's attitudes	PDS TA	I thought he would describe how he plans his lessons and not only when.
Researcher	Can you name information sources that you use to plan or prepare for each lesson?			
Teacher	I use textbooks, sometimes I use the internet.	Pedagogical skills Teacher's attitude	PDS TA	He seemed to consult different sources of information when preparing lessons
Researcher	How do you decide which learning activities to use in a lesson?			
Teacher	After I have taught, just to check whether these learners understand I had to write just a short activity on the board	Pedagogical skills	PDS	The response

	Interview Questions	Description of code	Code	Researcher's comment
	or prepare a worksheet.	Understanding learners	UL	was on assessing learning not choosing learning activity to use. He misunderstood the question.
Researcher	What do you do when learners are struggling to understand what you are teaching them?			
Teacher	Ah - yi I use to divide them to check those who are slow so that I can give them more activities and the intelligent ones I give them more challenging activities.	Pedagogical skills	PDS	It seemed he uses the differentiation as a teaching strategy to assist learners who are struggling.
		Understanding learners	UL	
Researcher	Ohkay, how do you accommodate learners with different learning styles?			
Teacher	Hence I am saying I am dividing them	Understanding learners	UL	He mentioned dividing them for differentiated teaching.
		Pedagogical skills	PDS	
Researcher	Yes ohkay, how do you help learners in understanding science when they have difficulty to understand the language?			
Teacher	Sometimes you had to code switch but you mustn't do always because we have multi classes here we have Pedis, Tsongas and Zulu languages. So, you must check which language suits them, there diverse languages sometimes use their mother tongue- just explain few words.	Understanding learners	UL	He understood that code switching was to be limited because of the different home languages in his
		Pedagogical skills	PDS	

	Interview Questions	Description of code	Code	Researcher's comment
				class.
Researcher	What kinds of experiences do you think enables learners to learn science?			
Teacher	I think is to do practical, practical work more often can help these learners.	Understanding learners	UL	He believed in learner engagement.
		Teacher's beliefs	TB	
Researcher	What do you think the Department of Education wanted you to learn from the ACE programme?			
Teacher	I think they want me to be.., hence I'm saying I must be more practical. Whereas in our case it's a challenge because we don't have facilities to make these learners do practical like teaching using computers. We have few computers. We need computers I have 250 learners I must reach them all. Also the overcrowding. It is difficult for these learners to understand science.	Outcomes of the ACE programme	OAP	He was not clear what the Department wanted him to learn from the ACE programme, he seemed to be overwhelmed with resource needs.
		Resource Needs	RN	
		Teacher's belief	TB	
Researcher	What do you think the University wanted you to learn from the ACE course?			
Teacher	You know when we were trained in ACE course they-they trained us more practical things, that we must apply practicality since science is more practical but it's difficult for us to do that with these challenges I have just mentioned. We have overcrowding, lack of resources like laboratories, apparatus and all those things.	Outcomes of the ACE programme	OAP	Also, he was not clear, he only knew that he needed to teach science practically and that he did not have sufficient resources.
		Resource Needs	RN	
		Teacher's attitude	TA	
Researcher	How did you think your classroom practice was expected to change after completing the ACE program?			
Teacher	Ja, it does change on my side because I have learnt a lot about the practical part of science. I was not a fan for	Teacher's beliefs	TB	It sounds like

	Interview Questions	Description of code	Code	Researcher's comment
	before I attended ACE everything was practical than theory.	Practical skills Outcomes of ACE programme Teacher's attitude	PS OAP TA	he learnt practical skills from the ACE programme and has changed his attitude to practical work.
Researcher	Do you think your subject knowledge has changed?			
Teacher	Ja, it has changed drastically.	Teacher's beliefs Teacher confidence Teacher's attitude	TB TC TA	He strongly believed his classroom practice has changed.
Researcher	Ohkay if yes, can you name a science concept you learnt and you are applying in class?			
Teacher	We had to allow learners to hypothesize to hypothesize-allow them to guess so that you can correct that guess thing. Like the theories other learners believe that 1+1 =2 like that…although the theory. They must guess what will happen if this and that happen. Then I will correct it.	Teacher's attitude Practical skills Outcomes of ACE programme	TA PS OAP	He did not answer the question as I was thinking he will mention science concepts as opposed to science process skill..
Researcher	Can you tell me about something you were taught in ACE which you are practicing in class?[the teacher was silent] Can you mention any best practice or experience you copied from ACE and you are implementing in class? Something like a best practice copied from ACE programme and you are using it to teach?.			
Teacher	Ja, like doing experiment. We use to do experiments in Wits. Let me do it like that we use that in my class. I have to improvise do practical sothat they can be able to see and try to do practicals sothat they can change.	Improvisation Outcomes of ACE programme	IMP OAP	He seemed to have learnt practical skills from the ACE programme but

	Interview Questions	**Description of code**	**Code**	**Researcher's comment**
				did not explain how he improvises.
Researcher	Did your learners' behaviour in class changed after you completed ACE?			
Teacher	Ja…ma……. yes, yes, yes	Learner outcomes Teacher confidence	LO TC	Very confident that learners' behaviour have changed positively.
Researcher	In which way?			
Teacher	You know I was getting I think eh…..out of 100 %, I think 60% learners will get a high mark but now definitely 80 to 90.	Learner outcomes Teacher's confidence	LO TC	He was confident that learners were now performing better.
Researcher	Ohkay, do you think learners are now enjoying science when you teach now that you have completed ACE?			
Teacher	Ja they enjoy it a lot. Ja, they enjoy it I do know whether I am excelling I don't know	Teacher's attitude Teacher confidence	TA TC	He suggested that he has now become a better teacher.
Researcher	Can you explain why do you think they are enjoying?			
Teacher	Maybe I am teaching of something that I had to add my extra knowledge based on that thing which does not cover the level of the grade…….I now…there are learners that are challenging they just pose a question whether they want to check how intelligent you are or they just test your knowledge in science. Now I am well equipped. I can answer any question in as far as science is concern.	Subject knowledge Learner outcomes Teacher confidence Outcomes of ACE programme	SK LO TC OAP	It seemed learners kept him on his toes by asking challenging questions. Now he actually says he has sufficient

	Interview Questions	**Description of code**	**Code**	**Researcher's comment**
				knowledge.
Researcher	Did you enjoy the ACE programme?			
Teacher	Ja, Eish, more than enjoying I don't know how to put it.	Teacher's attitude	TA	His attitude was that he enjoyed the ACE programme.
Researcher	Can you name a specific thing you enjoyed about ACE programme?			
Teacher	Eh content or I am enjoying most of the practical like atoms, Matter and Materials, like those core knowledge I enjoy them all.	Teacher's attitude Subject knowledge	TA SK	It seemed he enjoy content and practical on Matter and Materials
Researcher	Do you have more confidence in teaching science after completing the ACE?			
Teacher	More confidence, ja, I have confidence. I can answer anything as far as science is concern now.	Teacher confidence Teacher's attitude	TC TA	He was confident that he can teach science and he he thinks he can answer any question learners are posing.
Researcher	Can you explain the effect of your learners' responses on your new classroom practice now that you completed ACE? [The researcher was asked to repeat the question].			
Teacher	Ah.. they are 100% Ja,…… the feedback is good. Ja.	Teacher's beliefs Learners' outcomes	TB LO	He did not really answer the question but reflected that he was content about learners' outcomes.

	Interview Questions	Description of code	Code	Researcher's comment
Researcher	Would you be willing to share what you learnt in ACE in the cluster?			
Teacher	You know I was elected to conduct the CAPS training because I was training the teachers as far as science is concern. Even here in the school I am assisting as far as science is concern	Collaboration	C	It seemed he was willing to work with other teachers. This is about helping in the external domain as well.
		Outcomes of ACE programme	OAP	
		Teacher confidence	TC	
Researcher	Now the final one, is there any other thing you want to share about the ACE programme?			
Teacher	No, I think if this programme you are doing can be known to other colleagues. I mean this programme can be known to other colleagues. It's a good project really.	Teacher's attitude	TA	Here it sounded like data collection I was doing was a 'project'. But then he was referring to the ACE course that it was a good project.
Researcher	We have come to the end of the interview. Thank you.			

APPENDIX 13: MR ZULU LESSON OBSERVATIONS TRANSCRIPT

Mr Zulu lesson observations for lesson 1

Date of the observation	13 August 2013
School (Pseudonym)	Mngwenya Primary School
Name of the teacher (Pseudonym)	Mr Zulu
Subject	Natural Sciences
Grade	Grade 7
Number of learners	51
Period number and time	13h00
Lesson topic	Volcanic eruptions

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on volcanic eruptions was not presented but learners were presenting demonstrations on erupting volcano.
	Is the content explained correctly?	No content was presented.
	Is the teacher able to relate what he taught to real life examples?	The model of the volcano learners made related to the real volcano.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions in this lesson.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	Appropriate resources were selected and prepared beforehand in this lesson. Learners were required a day before to prepare a hard part of the model of the volcano.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	The content on volcano was reflected in the grade 7 work schedule provided by the district and also it is reflected in the RNCS document.
	Is the purpose of the experiment clearly stated?	The purpose was not written anywhere but learners were aware that they needed to demonstrate the model of erupting volcano.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Were apparatus checked beforehand for functionality?	There were no apparatus but learners prepared the stand as the model of the mountain using clay previously and this was to be used for the demonstration of the erupting volcano.
	Was there a worksheet or guideline on what to observe?	There was no worksheet designed in this lesson.
	What was the source of the worksheet?	There was no worksheet designed in this lesson.
	Were learners clarified as to what to write on the worksheet?	There was no worksheet designed in this lesson.
	How was the practical work assessed or the experiment assessed?	Mr Zulu used a rubric to assess the learners' demonstration by learners.
	Did learners perform hands-on practical work?	The demonstration of the erupting volcano was a hand-on practical work where learners worked in groups to demonstrate to the whole class.
	Did the teacher conduct practical demonstration?	The teacher did not conduct a demonstration in this lesson.
	If it was a demonstration, was it visible to all the learners? Explain how	The teacher did not conduct a demonstration in this lesson.
	What were the learners expected to do after seeing the demonstration?	The teacher did not conduct a demonstration in this lesson.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	The teacher did not conduct a demonstration in this lesson.
Pedagogical skills	Is there continuous assessment?	Mr Zulu only assessed learners' demonstration by group of learners. He assessed the modelling of the erupting volcano.
	How is the classroom managed?	The classroom was well managed even though the lesson was conducted outside.
	Does the teacher link content to learners' previous knowledge and context?	There was no revision of the previous knowledge in this lesson.

Elements of classroom practice to be observed	Question guiding observation	Comments
	How is the interaction of the teacher with learners?	There was cooperation observed in this lesson. Learners responded well when the teacher requested them to listen to other groups' presentation.
	How is learner participation, are they actively involved?	Learners were actively involved throughout this lesson where modelling of a volcano erupting was done.
	Is there evidence of cooperative learning?	As they were mixing ingredients to model the erupting volcano they assisted one another advising on the amount of the ingredients to add..
	Does the teacher use models/visual examples to explain science concepts?	The lesson was based on the model of a volcano to assist the teacher in explaining the content on volcano and volcanic eruptions.
	Are the various learning styles of learners accommodated in the lesson?	The lesson accommodated learners who learn best by doing and observing.
	Is the teacher aware of learners' typical misconceptions?	This was not demonstrated by the teacher in this lesson.
	Does the teacher use different strategies to teach? Explain how?	Presentation of the demonstration modelling the erupting volcano by learners was the only strategy used in this lesson.
	Does the teacher ask learners questions that cater for the different cognitive levels?	The teacher did not ask learners questions in this lesson. Learners were presenting in groups their erupting volcano.
	How much direct teaching does the teacher use?	No direct teaching happened in this lesson.
	How does the teacher use the discrepant event to clarify further for learners?	This was not observed in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	The group presentation was done in LoLT so the skill of speaking was supposed to be enhanced by this lesson.
	Does the teacher code appropriately	He did not code switch in this lesson.
Teachers' beliefs and attitudes in teaching	How confident is the teacher in teaching science?	The teacher was confident as he was assessing and scoring learners' demonstrations.

Elements of classroom practice to be observed	Question guiding observation	Comments
science	How is the enthusiasm of the teacher?	The teacher displayed enthusiasm observing the presentations made by learners.
	Does the teacher inspire the learners?	The teacher inspired the learners in this lesson by encouraging them to find out what caused some of the demonstrations to fail.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Working in groups on mixing the ingredient that will model the erupting volcano.	Learners displayed a lot of interest and motivation when demonstrating volcanic.	Well behaved though this lesson was a practical lesson with a potential of being disruptive but it did not happened.	Actively involved throughout the lesson.

Lesson observations for lesson 2
Classroom observation

Date of the observation	14 August 2013
School (Pseudonym)	Mngwenya Primary School
Name of the teacher (Pseudonym)	Mr Zulu
Subject	Natural Sciences
Grade	Grade 7
Number of learners	51
Period number and time	13h00
Lesson topic	Diagrammatical presentation of a volcano

Checklist for the lesson observation

Elements of classroom practice to be observed	Question guiding observation	Comments
Teachers' subject knowledge	Is the content presented correctly?	There was no actual content presented in this lesson. The teacher gave groups the scores for the demonstration performed in the previous lesson then drew a sketch of a volcano on the chalkboard.
	Is the content explained correctly?	The teacher explained different parts of the sketch drawn on the board labelling them. A magma chamber, lava, crater, layers of ash and ash cloud were labelled.
	Is the teacher able to relate what he taught to real life examples?	Mr Zulu related the model learners demonstrated and the sketch drawn on the board to the real volcano.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions in this lesson.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	This lesson was not an experiment.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	This lesson was not an experiment.
	Is the purpose of the experiment clearly stated?	This lesson was not an experiment.
	Were apparatus checked beforehand for functionality?	This lesson was not an experiment.
	Was there a worksheet or guideline on what to observe?	This lesson was not an experiment.
	What was the source of the worksheet?	This lesson was not an experiment.
	Were learners clarified as to what to write on the worksheet?	This lesson was not an experiment.
	How was the practical work assessed or the experiment assessed?	This lesson was not an experiment.
	Did learners perform hands-on practical work?	This lesson was not an experiment.
	Did the teacher conduct practical demonstration?	This lesson was a follow up lesson on the previous lesson where learners were presented their model of an erupting volcano.
	If it was a demonstration, was it visible to all the learners? Explain how	This lesson was a follow up lesson on the previous lesson where learners were presented their model of an erupting volcano.
	What were the learners expected to do after seeing the demonstration?	This lesson was a follow up lesson on the previous lesson where learners were presented their model of an erupting volcano.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	This lesson was a follow up lesson on the previous lesson where learners were presented their model of an erupting volcano.
Pedagogical skills	Is there continuous assessment?	There oral questioning by the teacher and learners answering question as the labelling of the sketch progressed.
	How is the classroom managed?	The classroom was well managed and the learners were listening.
	Does the teacher link content to learners' previous knowledge and context?	No new content was taught in this lesson.
	How is the interaction of the teacher with learners?	There was good interaction observed in this lesson as the labelling of the sketch progressed.
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lesson responding to the questions;
	Is there evidence of cooperative learning?	Cooperative learning was not observed in this lesson.
	Does the teacher use models/visual examples to explain science concepts?	It did not happened in this lesson.
	Are the various learning styles of learners accommodated in the lesson?	Only labelling of the sketch occurred in this lesson.
	Is the teacher aware of learners' typical misconceptions?	It was not observed in this lesson.
	Does the teacher use different strategies to teach? Explain how?	It was not observed in this lesson.
	Does the teacher ask learners questions that cater for the different cognitive levels?	Only the "what do you think..." question was asked in this lesson.
	How much direct teaching does the teacher use?	Only labelling occurred in this lesson.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	How does the teacher use the discrepant event to clarify further for learners?	It was no observed in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	It was no observed in this lesson.
	Does the teacher code appropriately	He did not code switch in this lesson.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher displayed confidence in teaching science as he was labelling the sketch of the volcano.
	How is the enthusiasm of the teacher?	The teacher was enthusiastic making a drawing on the chalkboard and labelling the sketch.
	Does the teacher inspire the learners?	This was done through question and answer.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
They were actively listening to the teacher.	Their facial expressions indicated that they had an interest in the lesson.	Well behaved throughout the lesson.	Actively involved throughout the lesson.

Lesson observations for lesson 3

Classroom observation

Date of the observation	15 August 2013
School (Pseudonym)	Mngwenya Primary School
Name of the teacher (Pseudonym)	Mr Zulu
Subject	Natural Sciences
Grade	Grade 7
Number of learners	51
Period number and time	12h00
Lesson topic	The compass

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on what a compass is and cardinal points was correctly presented.
	Is the content explained correctly?	The teacher explained the content correctly.
	Is the teacher able to relate what he taught to real life examples?	Mr Zulu related the lesson on the compass and cardinal point to towns lying southwards, northwards, eastwards and northwards.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	There were no experiments conducted in this lesson.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	There were no experiments conducted in this lesson.
	Is the purpose of the experiment clearly stated?	There were no experiments conducted in this lesson.
	Were apparatus checked beforehand for functionality?	There were no experiments conducted in this lesson.
	Was there a worksheet or guideline on what to observe?	There were no experiments conducted in this lesson.

	What was the source of the worksheet?	There were no experiments conducted in this lesson.
	Were learners clarified as to what to write on the worksheet?	There was no worksheet
	How was the practical work assessed or the experiment assessed?	There were no experiments conducted in this lesson.
	Did learners perform hands-on practical work?	Learners were listening to the teacher teaching.
	Did the teacher conduct practical demonstration?	A teacher conducted a practical demonstration where he used one learner to go stand outside where the other learners in the classroom could see him. Other learners were required to observe the shadow of the learner.
	If it was a demonstration, was it visible to all the learners? Explain how	Not all learners could see his shadow.
	What were the learners expected to do after seeing the demonstration?	Learners were expected to conclude the eastward direction from this demonstration.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	There was no assessment based on the demonstration.
Pedagogical skills	Is there continuous assessment?	Question asked were: “what is a compass”?, “name four cardinal points”, point eastwards, point northwards, point westwards, point southwards.
	How is the classroom managed?	The classroom was well managed.
	Does the teacher link content to learners’ previous knowledge and context?	Linking prior knowledge was not observed in this lesson.
	How is the interaction of the teacher with learners?	There was good interaction observed during the lesson, learners cooperating with the teacher.
	How is learner participation, are they actively involved?	Learners were actively involved in this lesson and one learner was used for demonstrating eastwards.
	Is there evidence of cooperative learning?	There was no evidence of cooperative learning in this lesson.

	Does the teacher use models/visual examples to explain science concepts?	The teacher has used a demonstration through the learner to explain how to find eastwards direction.
	Are the various learning styles of learners accommodated in the lesson?	A demonstration part of the lesson favoured learners who learn best by seeing.
	Is the teacher aware of learners' typical misconceptions?	This was not observed in this lesson.
	Does the teacher use different strategies to teach? Explain how?	In this lesson direct teaching and demonstration was used.
	Does the teacher ask learners questions that cater for the different cognitive levels?	It did not happened question asked were: "what is a compass"?, "name four cardinal points", point eastwards, point northwards, point westwards, point southwards. All were low order questions.
	How much direct teaching does the teacher use?	The teacher was mainly using direct teaching in this lesson.
	How does the teacher use the discrepant event to clarify further for learners?	This was not observed in this question.
Language skills	Do the planned learning activities accommodate language skills?	The teacher in this lesson insisted that the learners should pronounce the word compass correctly. Reading correctly was emphasized.
	Does the teacher code appropriately	He code switched calling the cardinal points in isiZulu.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher was confident in teaching science.
	How is the enthusiasm of the teacher?	The teacher was enthusiastic in explaining the content.
	Does the teacher inspire the learners?	The teacher inspired the learners by asking them questions.

Description of Learners' behaviour			
Learners' active participation in	**Motivation and interest in the**	**Learner behaviour in the class**	**Use of resources or apparatus by**

the lesson	lesson		learners
Learners were actively listening.	They have shown interest in the lesson.	Well behaved.	Actively involved throughout the lesson answering questions.

Lesson observations for lesson 4
Classroom observation

Date of the observation	20 August 2013
School (Pseudonym)	Mngwenya Primary School
Name of the teacher (Pseudonym)	Mr Zulu
Subject	Natural Sciences
Grade	Grade 7
Number of learners	51
Period number and time	10h00
Lesson topic	Revision on the compass

Checklist for the lesson observation

Elements of classroom practice to be observed	Question guiding observation	Comments
Teachers' subject knowledge	Is the content presented correctly?	The content was correctly presented and this lesson was a revision on the compass.
	Is the content explained correctly?	The teacher wrote the definition of compass on the board and he did not explain.
	Is the teacher able to relate what he taught to real life examples?	He asked learners what were the sailors using in the past to find direction.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	This was not an experiment.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	This was not an experiment.
	Is the purpose of the experiment clearly stated?	This was not an experiment.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Were apparatus checked beforehand for functionality?	This was not an experiment.
	Was there a worksheet or guideline on what to observe?	This was not an experiment.
	What was the source of the worksheet?	This was not an experiment.
	Were learners clarified as to what to write on the worksheet?	This was not an experiment.
	How was the practical work assessed or the experiment assessed?	This was not an experiment.
	Did learners perform hands-on practical work?	Learners listened while the teacher was talking
	Did the teacher conduct practical demonstration?	He did not conduct practical demonstration.
	If it was a demonstration, was it visible to all the learners? Explain how	He did not conduct practical demonstration.
	What were the learners expected to do after seeing the demonstration?	He did not conduct practical demonstration.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	Yes assessment was conducted towards the end of the period where they were given class work to write.
Pedagogical skills	Is there continuous assessment?	Oral questions were asked to assess the learners understanding on the compass and cardinal point.
	How is the classroom managed?	The classroom was well managed.
	Does the teacher link content to learners' previous knowledge and context?	The lesson was about the previous knowledge.
	How is the interaction of the teacher with learners?	There was good interaction observed.

Elements of classroom practice to be observed	Question guiding observation	Comments
	How is learner participation, are they actively involved?	Learners were actively involved throughout the lesson answering question.
	Is there evidence of cooperative learning?	This was not observed.
	Does the teacher use models/visual examples to explain science concepts?	No visuals or models were used in this lesson.
	Are the various learning styles of learners accommodated in the lesson?	Only direct teaching and oral questioning was used.
	Is the teacher aware of learners' typical misconceptions?	It was not observed in this lesson.
	Does the teacher use different strategies to teach? Explain how?	Direct teaching and question and answer were used.
	Does the teacher ask learners questions that cater for the different cognitive levels?	In this lesson only recall questions were asked: what is the compass? What are the uses of the compass?
	How much direct teaching does the teacher use?	Direct teaching was used well combined with oral questions.
	How does the teacher use the discrepant event to clarify further for learners?	This was not observed in this question.
Language skills	Do the planned learning activities accommodate language skills?	There was no observation of such in this lesson.
	Does the teacher code appropriately?	The teacher code switch appropriately in this lesson.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher was confident in teaching science and he challenged learners to ask questions.
	How is the enthusiasm of the teacher?	The teacher was enthusiastic re-teaching about the compass.
	Does the teacher inspire the learners?	The teacher inspired the learners through question and answer.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners actively participated in answering questions.	They were interested in the lesson though it was a revision lesson.	Well were well behaved.	No resources were used in this lesson except for the use of their workbook for writing class work.

Lesson observations for lesson 5
Classroom observation

Date of the observation	02 September 2013
School (Pseudonym)	Mngwenya Primary School
Name of the teacher (Pseudonym)	Mr Zulu
Subject	Natural Sciences
Grade	Grade 7
Number of learners	51
Period number and time	10h00
Lesson topic	Feedback on the previous lesson

Checklist for the lesson observation

Elements of classroom practice to be observed	Question guiding observation	Comments
Teachers' subject knowledge	Is the content presented correctly?	The teacher was sick on this day, he only provided learners with feedback of the previous day classwork.
	Is the content explained correctly?	No explanation done, learners were called to come write the correct responses on the board.
	Is the teacher able to relate what he taught to real life examples?	This was not evident in this lesson.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	No experiment was conducted in this lesson.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	No experiment was conducted in this lesson.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Is the purpose of the experiment clearly stated?	No experiment was conducted in this lesson.
	Were apparatus checked beforehand for functionality?	No experiment was conducted in this lesson.
	Was there a worksheet or guideline on what to observe?	No experiment was conducted in this lesson.
	What was the source of the worksheet?	No experiment was conducted in this lesson.
	Were learners clarified as to what to write on the worksheet?	No experiment was conducted in this lesson.
	How was the practical work assessed or the experiment assessed?	No experiment was conducted in this lesson.
	Did learners perform hands-on practical work?	Learners only participated in writing feedback on the board as the teacher was calling them.
	Did the teacher conduct practical demonstration?	There was no demonstration conducted in this lesson.
	If it was a demonstration, was it visible to all the learners? Explain how	There was no demonstration conducted in this lesson.
	What were the learners expected to do after seeing the demonstration?	There was no demonstration conducted in this lesson.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	There was no demonstration conducted in this lesson.
Pedagogical skills	Is there continuous assessment?	Responding to the previous class work conducted.
	How is the classroom managed?	The classroom was well managed.
	Does the teacher link content to learners' previous knowledge and context?	Lesson was based on giving feedback on the previous lesson.
	How is the interaction of the teacher with learners?	There was good interaction observed.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	How is learner participation, are they actively involved?	Participated in writing the feedback on the board.
	Is there evidence of cooperative learning?	Cooperative learning was not observed.
	Does the teacher use models/visual examples to explain science concepts?	No models or visuals were used.
	Are the various learning styles of learners accommodated in the lesson?	Learning styles were not really accommodated in this lesson.
	Is the teacher aware of learners' typical misconceptions?	This was not observed in this lesson.
	Does the teacher use different strategies to teach? Explain how?	The lesson was only about giving learners feedback.
	Does the teacher ask learners questions that cater for the different cognitive levels?	It did not happened in this lesson.
	How much direct teaching does the teacher use?	Feedback session only focussed on recall questions asked by learners.
	How does the teacher use the discrepant event to clarify further for learners?	Feedback session only focussed on recall questions asked by learners.
Language skills	Do the planned learning activities accommodate language skills?	Feedback session only focussed on recall questions asked by learners.
	Does the teacher code appropriately	He code switch as the feedback questions progressed.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher was sick on this day. He was talking seated the most part of the lesson.
	How is the enthusiasm of the teacher?	He was sick with flue he did not show any enthusiasm.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Does the teacher inspire the learners?	Learners were not inspired on this day.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners assisted in writing homework on the chalkboard.	Interest and motivation was low.	Well behaved.	No resources usage except writing on the workbooks.

Lesson observations for lesson 6
Classroom observation

Date of the observation	03 September 2013
School (Pseudonym)	Mngwenya Primary School
Name of the teacher (Pseudonym)	Mr Zulu
Subject	Natural Sciences
Grade	Grade 7
Number of learners	51
Period number and time	8h00
Lesson topic	Mixtures.

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on mixtures was correctly presented.
	Is the content explained correctly?	The teacher explained the terms: a mixture, pure substances, solution, solute, solvent.
	Is the teacher able to relate what he taught to real life examples?	Ingredients for making mixtures were brought from home.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	Yes different foods were brought from home by learners for the practical activity.
	Was the experiment suitable for Senior Phase? (comment on the relevancy of the experiment to the curriculum)	Mixtures was found that it was suitable for Senior Phase according to the work schedule The experiment conducted on mixtures was relevant to the curriculum as reflected in the pace setter for grade 7 in Gauteng East District and also in the RNCS document.
	Is the purpose of the experiment clearly stated?	It was clarified that learners should make mixtures of their choice.
	Were apparatus checked beforehand for functionality?	Learners brought ingredients from home.
	Was there a worksheet or guideline on what to observe?	There was no worksheet designed for this lesson.
	What was the source of the worksheet?	There was no worksheet designed for this lesson.
	Were learners clarified as to what to write on the worksheet?	There was no worksheet designed for this lesson.
	How was the practical work assessed or the experiment assessed?	The teacher drew a sketch modelling the pure substances and mixtures. Learners were to choose which models represented mixtures and which represented pure substances. The actual practical was not assessed.
	Did learners perform hands-on practical work?	Yes they did in this lesson combining ingredients brought from home.
	Did the teacher conduct practical demonstration?	No practical demonstration was conducted.
	If it was a demonstration, was it visible to all the learners? Explain how	No practical demonstration was conducted.
	What were the learners expected to do after seeing the demonstration?	No practical demonstration was conducted.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	No practical demonstration was conducted.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Pedagogical skills	Is there continuous assessment?	There was oral questioning on mixtures and terms related to mixtures. from the beginning of the lesson till the end of the lesson.
	How is the classroom managed?	The classroom was well managed learners were supervised as they made mixtures.
	Does the teacher link content to learners' previous knowledge and context?	The lesson started without revising the previous knowledge.
	How is the interaction of the teacher with learners?	There was good interaction observed, the teacher supervised learners by moving from group to group.
	How is learner participation, are they actively involved?	Learners were actively involved mixing ingredients/households substances.
	Is there evidence of cooperative learning?	Learners worked together whiles making mixtures.
	Does the teacher use models/visual examples to explain science concepts?	The visuals used in this lesson were the ingredients brought from home to make mixtures.
	Are the various learning styles of learners accommodated in the lesson?	Group work, presentation of mixtures and oral questions.
	Is the teacher aware of learners' typical misconceptions?	It was not observed in this lesson.
	Does the teacher use different strategies to teach? Explain how?	Different strategies of teaching used were: Group work, presentation of mixtures and oral questions.
	Does the teacher ask learners questions that cater for the different cognitive levels?	The teacher wanted to know the understanding of learners on the terms used in the lesson on mixtures. Questions asked were: What is a mixture? What is the difference between a mixture and a pure substance? What is a solution, what is a solvent? What is a solute?
	How much direct teaching does the teacher use?	There was minimal direct teaching as learners were engaged in the practical activity.
	How does the teacher use the discrepant event to clarify further for learners?	It was not observed in this lesson.
Language skills	Do the planned learning activities accommodate language skills?	Reading of terms written on the board was done: mixture, pure substance, solution, solute and solvent.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Does the teacher code appropriately	He code switch appropriately explaining how they should mix the ingredients.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The teacher was confident in this lesson moving from desk to desk.
	How is the enthusiasm of the teacher?	The teacher was enthusiastic challenging the learners and asking them if their mixtures can be separated.
	Does the teacher inspire the learners?	The teacher inspired the learners through question and answer.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Working in groups making mixtures and presenting the mixtures they made to the whole class.	They shown interest and motivation when presenting their prepared mixtures to the whole class.	Well behaved.	Actively involved throughout the lesson making mixtures.

APPENDIX 14: MR ZULU DOCUMENT ANALYSIS

School (Pseudonym): Mngwenya Primary School
Date collected: August to December 2013
Importance of the document: To confirm the kind of activities given to learners and the frequency
Document analysis Guide 1: Learners' daily workbooks

CRITERIA	Comments
Activities based on practical work	✓ There are activities based on practical work ✓ Learners have written work on each topic taught according to the work schedule.
Frequency of written work	✓ Written work were 11 in January, in February 6, one in March, 11 in April, 12 in May, one in June, 5 in July and 4 in August
Accuracy of feedback or corrections given to learners by the teacher;	✓ Corrections were reflected in the learners' workbooks. ✓ Mr Zulu controlled the workbooks. ✓ The feedback/corrections in the learners' workbooks were correct.
Activities that require high order thinking;	✓ There are activities where learners were expected to describe, draw and apply information learnt. ✓ Mainly there were recall kind of questions.
Evidence of various forms of assessment given to learners;	✓ Various forms of assessment were found ranging from recall to interpreting information. ✓ There were tests class work, and examinations.

Document analysis Guide 2: Teacher documents and records (Work Schedule, lesson preparation and programme of assessment**)**

CRITERIA	Comments
Activities in teacher planning that involve practical work	✓ There were planned worksheets and activities for learners to do. ✓ Work schedule reflected content where practical tasks could be done ✓ Lesson preparations reflected content where practical tasks could be done ✓ Programme of assessment contained project, translation task and investigation where investigation could be a practical task.
Science content covered for the	✓ The planned activities reflected science content for the as per the work schedule

grade in the planning	that was supplied by the school.
Learners assessment records, planned for various learning styles	✓ Programme of assessment for the year reflected the different forms of assessment. ✓ Records revealed project, translation task and investigation
Recording sheets for the learner performance	✓ Learners' list reflecting names of learners with allocated marks was found in the teacher's file. ✓ Learners' marks ranged from 20% to 80%

APPENDIX 15: INTERVIEW TRANSCRIPT FOR MS NTOMBELA

	Interview Questions	Description of code	Code	Researcher's comments
Researcher	Do you believe that you have sufficient subject knowledge to teach the syllabus in NS grade 7?			
Teacher	No.	Teacher's beliefs	TB	The 'No' initially sounded like she did not have sufficient subject knowledge.
Researcher	Why?			
Teacher	I have got all the information in order for the learner to understand much better.	Subject knowledge	SK	She sounded like she does not have it well but she had information sources to consult.
Researcher	Do you believe that you have sufficient practical skills to do the prescribed experiments in grade 7?			
Teacher	No	Practical skills	PS	She did not hesitate that she did not have sufficient practical skills.
Researcher	Why do you say "No"?			
Teacher	Hmmm, most of the ama-science equipment. Some of the learners learn better, so there much learner. Others are barriers so if they can see something it much more understanding.	Understanding learners	UL	She seemed to understand that learners learn science better when they can see and there is equipment, but she did not explain why she thinks that she lacks skills.
		Practical skills	PS	
		Resource needs	RN	
Researcher	How often do you do experiments with learners?			

Teacher	Per week, it depends, it depends on the content.	Practical skills	PS	The content she is teaching determines the frequency of conducting experiments.
Researcher	Do you have enough apparatus to do experiments?			
Teacher	Yes	Teacher's attitudes	TA	In this school there is a laboratory with apparatus.
Researcher	Okay, do you sometimes use improvised apparatus? [She was silent, then I continued to say] like a beaker.			
Teacher	Yes, that's why I sometimes, they bring at home.	Improvisation	IMP	Though she earlier indicated that there is a laboratory in the school, learners still bring from home.
		Teacher's attitude	TA	
Researcher	I saw you plan lessons [When I arrived in the school she was busy with lesson preparations], which information sources you use to plan and prepare for each lesson?			
Teacher	Ja, I took from the NCS, NCS is a guideline. It guides you where must I start where must I end up. Especially from the column of teacher's activities, learners' activities.	Teacher's beliefs Pedagogical skills	TB PDS	She believed that the NCS is a guideline for planning lessons.
Researcher	How do you decide which learning activities to use when teaching?			
Teacher	The activities? Ama..ama ama like ama-resources like ama- posters charts.	Pedagogical skills	PDS	She use posters and charts but she did not mention how she decides which learning activities to use when teaching.
Researcher	What do you do when learners are struggling to understand what you are teaching them?			

Teacher	I use the various method of teaching I move from the simplest to the complex.	Understanding learners Pedagogical skills	UL PDS	It sounded like she understood how to accommodate learners who are struggling when she is teaching.
Researcher	How do you accommodate learners with different learning styles?			
Teacher	Like I say before I use various method.	Understanding learners Pedagogical Skills	UL PDS	She treated learners with different learning styles the same as those who are struggling to understand what she was teaching.
Researcher	What kinds of experiences do you think enables learners to learn science?			
Teacher	I use science equipment, science equipment.	Understanding learners Teacher's belief	UL TB	She used equipment to conduct practical work for learners to learn science.
Researcher	What do you think the Department of Education wanted you to learn from the ACE programme?			
Teacher	In order to develop skill of teaching and ja to develop the skills of teaching.	Outcomes of the ACE programme	OAP	She believed the Department wanted to develop her skills of teaching.
Researcher	What do you think the University wanted you to learn?			
Teacher	To develop the skills of learning and teaching for my kids.	Outcomes of the ACE programme	OAP	She sounded certain that the University wanted to develop her skills of learning and teaching.
Researcher	How did you think your classroom practice was expected to change?			
Teacher	Yes eh…50% change by doing the various methods to teach I learn from ACE.	Pedagogical skills	PDS	It seems she believed that she has changed to

		Outcomes of the ACE programme	OAP	a certain extent.
Researcher	Do you think your subject knowledge has improved?			
Teacher	Yes.	Teacher's beliefs Subject knowledge	TB SK	She believed her subject knowledge has improved
Researcher	Can you name one science concepts you think you learnt in ACE? If no, why do you think you did not learn anything from ACE?			
Teacher	Like matter I understand more matter I did not understand before but while I took i-ACE I understand more matter, most of the time.	Subject knowledge Outcomes of ACE programme	SK OAP	She was certain that now she understands the strand on Matter and Materials.
Researcher	Can you tell me about something you have learnt in ACE which you are practicing in class?			
Teacher	Phases of matter like solid, liquid, gas.	Subject knowledge	SK	So, phases of matter were also learnt from ACE
Researcher	Okay you are practicing that in class? Did your learners' behaviour in class changed after you have done ACE?			
Teacher	Yes. They change but more towards teaching.	Teacher's beliefs Outcomes of the ACE programme	TB OAP	She believed learners have changed probably the teacher enjoys teaching them now.
Researcher	Do you think now learners are enjoying science?			
Teacher	While I am active they enjoy much. Like phases of matter the learners do not understand evaporation, solids.	Outcomes of the ACE programme Subject knowledge	OAP SK	Learners are enjoying her lessons probably when she is active like doing demonstration activities.
Researcher	Did you enjoy the ACE programme?			
Teacher	Yes	Teacher's attitudes	TC	She was certain that she enjoyed the ACE programme.

Researcher	Can you name a specific concept that you enjoyed about ACE programme?			
Teacher	Like ah question of hypothesis. Most of the question what if the rain, like the cloud solids the question what if? What if? Even if learners don't see the rain but they understand easier.	Teacher's beliefs Practical skills Outcomes of the ACE programme	TB PS OAP	She sounded like she learnt a scientific method where hypothesising was one of the steps.
Researcher	Are you enjoying teaching science more than before you completed the ACE programme?			
Teacher	Much more.	Teacher's beliefs Outcomes of ACE programme	TB OAP	She believed that now she is enjoying teaching science.
Researcher	Can you mention a specific thing you enjoy in teaching science?			
Teacher	Like ah! Doing practical, we experience daily life at home and even at school. Learners will come and Mam what happens their fathers, their mothers know but there is something only to find that their mothers are not well educated. There is something like their forefathers know.	Teacher's beliefs Practical skills	TB PS	She seemed to like doing practical work and allowing learners to learn from parents and grandparents.
Researcher	Do you have more confident in teaching science now? What do you think?			
Teacher	Ja, by sharing the ideas information like kuma-cluster meeting we share information.	Collaboration Teacher confidence Outcomes of the ACE programme	C TC OAP	Though she is not a cluster leader she seemed to be sharing information in the cluster.
Researcher	Can you explain the effect of your learners' responses on your new classroom practice? In other words do you struggle with learners who do not write home works and submit assignments late?			
Teacher	No, most of them are not struggling but some little learners I think it depend from their parents, it depending on their parents are not educated they come late.	Teacher's attitude Learner outcomes	TA LO	Though she believed some or few learners are fine , there are some who are problematic.

Researcher	Would you be willing to share what you have learnt in ACE in the cluster meeting?			
Teacher	Yes-ja yes	Teacher confidence	TC	She mentioned earlier on that she was sharing in the cluster.
		Collaboration	C	
Researcher	Can you explain how the ACE NS programme has changed the way you believe and view yourself as a science teacher?			
Teacher	Like I am brainstorming i-ACE NS. Other educators they must focus on various teaching methods. You can change by teaching various teaching methods. You can change the method. You can see like teaching grade 7A, B, C. On A learners may understand more. You can change the method.	Teacher's beliefs	TB	It was not clear how the ACE programme has change the way she view herself. She decided to talk about teaching methods.
		Pedagogical skills	PDS	
Researcher	Is there any other thing you want to share? If there is nothing no problem.			
Teacher	Yes mam I like science because it explain daily life. Everything that we do is science.	Teacher's beliefs	TB	She sounded like having positive attitude towards science
		Teacher's attitude	TA	
Researcher	Thank you so much we have come to the end of the interview.			

APPENDIX 16: MS NTOMBELA LESSON OBSERVATIONS TRANSCRIPT

Lesson observations for lesson 1

Date of the observation	13 August 2013
School (Pseudonym)	Ntonto Primary
Name of the teacher (Pseudonym)	Ms Ntombela
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	8h00
Lesson topic	The changing of the earth surface

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on the changing earth was correctly presented.
	Is the content explained correctly?	The explanation of the content on the changing earth was done. The teacher led the learners to read directly from the textbooks.
	Is the teacher able to relate what he taught to real life examples?	The content was not related to real life examples.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	In this lesson no experiment was done.
	Is the purpose of the experiment clearly stated?	In this lesson no experiment was done.
	Were apparatus checked beforehand for functionality?	In this lesson no experiment was done.

Elements of classroom practice to be observed	Question guiding observation	Comments
	Was there a worksheet or guideline on what to observe?	In this lesson no experiment was done.
	What was the source of the worksheet or guidelines (If any)?	In this lesson no experiment was done.
	Were learners clarified as to what to write on the worksheet?	In this lesson no experiment was done.
	Was the experiment suitable for the Senior Phase?	In this lesson no experiment was done.
	How was the practical work assessed or the experiment assessed?	In this lesson no experiment was done.
	Did learners perform hands-on practical work?	Learners did not perform hands on practical activities.
	Did the teacher conduct practical demonstration?	No practical demonstration was conducted by the teacher.
	If it was a demonstration, was it visible to all the learners? Explain how	This lesson was not a practical demonstration.
	What were the learners expected to do after seeing the demonstration?	This lesson was not a practical demonstration.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	This lesson was not a practical demonstration.
Pedagogical skills	Is there continuous assessment?	Oral question and answer to assess their understanding as the lesson progressed was done.
	How is the classroom managed?	The teacher spent about ten minutes disciplining the learners for not listening and for looking around when she was teaching.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Does the teacher link content to learners' previous knowledge and context?	Asked were: What landforms and physical features can you see in the picture? What landforms and physical features can you see in the school? What causes the changes?
	How is the interaction of the teacher with learners?	The interaction was not bad, Ms Ntombela posed questions.
	How is learner participation, are they actively involved?	Learners were actively involved by answering questions, reading from the textbook as per the teacher instruction.
	Is there evidence of cooperative learning?	Opportunities were never created for the learners to work cooperatively in the lesson.
	Does the teacher use models/visual examples to explain science concepts?	The teacher was reading from the textbook, she did not use visuals to explain science concepts.
	Are the various learning styles of learners accommodated in the lesson?	Reading from the textbook and asking learners oral questions based on what they were reading was done.
	Is the teacher aware of learners' typical misconceptions?	This was not observed.
	Does the teacher use different strategies to teach? Explain how?	The teacher used textbook and question and answer method in this lesson.
	Does the teacher ask learners questions that cater for the different cognitive levels?	Only low order questions were asked.
	How much direct teaching does the teacher use?	The teacher mainly used direct teaching.
	How does the teacher use the discrepant event to clarify further for learners?	This was not evident in the lesson presented by the teacher.
Language skills	Do the planned learning activities accommodate language skills?	Reading from the textbook enhanced reading skills of learners.
	Does the teacher code appropriately	The teacher code switched all the time as she explained what the learners were reading.
Teachers' beliefs and	How confident is the teacher in	She referred from her preparations as well as textbook as teaching progresses and was confident.

Elements of classroom practice to be observed	Question guiding observation	Comments
attitudes in teaching science	teaching science?	
	How is the enthusiasm of the teacher?	She displayed enthusiasm that was observed when she was teaching.
	Does the teacher inspire the learners?	Through oral questions and answers attempts were made to inspire learners.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners were participating in the lesson by answering questions posed by the teacher.	Learners were interested in the lesson.	Learners were conscious that the teacher will spend minutes reprimanding them hence were on the alert and behaved.	Use of resources was very minimal as the teacher used a textbook method.

Lesson observations for lesson 2
Classroom observation

Date of the observation	14 August 2013
School (Pseudonym)	Ntonto Primary
Name of the teacher (Pseudonym)	Ms Ntombela
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	9h00
Lesson topic	Results of plate movement

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on plates movement were presented correctly; the teacher used a textbook method.
	Is the content explained correctly?	The explanation of the content was done correctly as learners were reading from their textbook simultaneously the teacher stopped them and explain.
	Is the teacher able to relate what he taught to real life examples?	The teacher did not relate what was taught to real life example.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	No experiment done in this lesson.
	Is the purpose of the experiment clearly stated?	No experiment done in this lesson.
	Were apparatus checked beforehand for functionality?	No experiment done in this lesson.
	Was there a worksheet or guideline on what to observe?	No experiment done in this lesson.
	What was the source of the worksheet or guidelines (If any)?	No experiment done in this lesson.
	Were learners clarified as to what to write on the worksheet?	No experiment done in this lesson.
	Was the experiment suitable for the Senior Phase?	No experiment done in this lesson.
	How was the practical work assessed or the experiment assessed?	No experiment done in this lesson.
	Did learners perform hands-on practical work?	It was not a hands-on practical work
	Did the teacher conduct practical demonstration?	The teacher did not conduct a practical demonstration.
	If it was a demonstration, was it visible to all the learners? Explain how	The teacher did not conduct a practical demonstration.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	What were the learners expected to do after seeing the demonstration?	The teacher did not conduct a practical demonstration.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	The teacher did not conduct a practical demonstration.
Pedagogical skills	Is there continuous assessment?	An oral question to assess their understanding as they were reading from their textbook was done.
	How is the classroom managed?	The teacher spent about 10 minutes disciplining the learners for not listening and for looking around when she was teaching.
	Does the teacher link content to learners' previous knowledge and context?	The teacher requested one learner to come and write corrections on the board. The rest of the learners were required to give answers.
	How is the interaction of the teacher with learners?	The interaction was not bad. The teacher asked questions and learners responded.
	How is learner participation, are they actively involved?	Learners were actively involved reading from the textbook as per the teacher instruction. Also they were voluntarily raising their hands and answering questions asked by the teacher.
	Is there evidence of cooperative learning?	Opportunities were never created for the learners to work cooperatively.
	Does the teacher use models/visual examples to explain science concepts?	The teacher was reading from the textbook mainly, no visuals were used.
	Are the various learning styles of learners accommodated in the lesson?	Learners who learnt best from reading benefitted the most as the teacher was teaching using the textbook method.
	Is the teacher aware of learners' typical misconceptions?	This was not observed.
	Does the teacher use different strategies to teach? Explain how?	The teacher used textbook method and occasionally learners wrote their responses on the chalk board as per the teacher's instruction. She was mainly teaching from the textbook.
	Does the teacher ask learners questions that cater for the different cognitive levels?	Only low order questions were asked. These questions were read from the textbook: What are the results of plates' movement? What is happening in the first picture? What is happening in the second picture?

Elements of classroom practice to be observed	Question guiding observation	Comments
	How much direct teaching does the teacher use?	The lesson was direct teaching from the textbook.
	How does the teacher use the discrepant event to clarify further for learners?	This was not evident in the lesson.
Language skills	Do the planned learning activities accommodate language skills?	Learners were reading line by line from the textbook.
	Does the teacher code switch appropriately	The teacher code switched inappropriately, spending the major part of the lesson explaining in isiZulu.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	She was confident, reading from the textbook.
	How is the enthusiasm of the teacher?	She was willing to clarify more for learners.
	Does the teacher inspire the learners?	Through oral questions attempts were made to inspire learners.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners were participating in the lesson by answering questions posed by the teacher.	Learners showed interest in the lesson answering questions.	Learners were well behaved as they were always conscious that the teacher will spend minutes reprimanding them.	Use of resources except the individual textbook did not happen.

Lesson observations for lesson 3
Classroom observation

Date of the observation	15 August 2013
School (Pseudonym)	Ntonto Primary
Name of the teacher (Pseudonym)	Ms Ntombela

Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	10h00
Lesson topic	Assessment for the district

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	There was no teaching in this lesson, Ms Ntombela gave learners bulbs, wires and cells to try connections that will make the bulb to glow whiles she concentrated on the district assessment records.
	Is the content explained correctly?	No teaching took place.
	Is the teacher able to relate what he taught to real life examples?	No teaching took place.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	Apparatus were not organised except that learners asked for themselves from the teacher's cardboard
	Is the purpose of the experiment clearly stated?	They were told to connect wires, cells and bulb such that the bulb will glow.
	Were apparatus checked beforehand for functionality?	They were not checked and learners were did trial and error
	Was there a worksheet or guideline on what to observe?	No worksheet was organised.
	What was the source of the worksheet or guidelines (If any)?	No worksheet was organised.
	Were learners clarified as to what to write on the worksheet?	No worksheet was organised.
	Was the experiment suitable for the Senior Phase?	The experiment was not suitable for Senior Phase.
	How was the practical work assessed or the experiment assessed?	It was not assessed as it was just a means of keeping the learners busy.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Did learners perform hands-on practical work?	Learners were performing hands-on experiment.
	Did the teacher conduct practical demonstration?	No practical demonstration was conducted by the teacher.
	If it was a demonstration, was it visible to all the learners? Explain how	No practical demonstration was conducted by the teacher.
	What were the learners expected to do after seeing the demonstration?	No practical demonstration was conducted by the teacher.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	No practical demonstration was conducted by the teacher.
Pedagogical skills	Is there continuous assessment?	Nothing was assessment.
	How is the classroom managed?	Ms Ntombela concentrated on the district assessment record she was busy with, she did not manage the class.
	Does the teacher link content to learners' previous knowledge and context?	No teaching has occurred.
	How is the interaction of the teacher with learners?	No interaction was observed.
	How is learner participation, are they actively involved?	They were actively trying to get their light bulbs glowing.
	Is there evidence of cooperative learning?	No cooperative learning was observed.
	Does the teacher use models/visual examples to explain science concepts?	The teacher focussed on district assessment records.
	Are the various learning styles of learners accommodated in the lesson?	The teacher focussed on district assessment records.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Is the teacher aware of learners' typical misconceptions?	The teacher focussed on district assessment records.
	Does the teacher use different strategies to teach? Explain how?	The teacher focussed on district assessment records.
	Does the teacher ask learners questions that cater for the different cognitive levels?	The teacher focussed on district assessment records.
	How much direct teaching does the teacher use?	The teacher focussed on district assessment records.
	How does the teacher use the discrepant event to clarify further for learners?	The teacher focussed on district assessment records.
Language skills	Do the planned learning activities accommodate language skills?	No teaching took place.
	Does the teacher code appropriately	No teaching took place.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	The focus was on district assessment.
	How is the enthusiasm of the teacher?	Handling apparatus on their own.
	Does the teacher inspire the learners?	No teaching took place.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners were trying to get their bulb glowing	Learners were excited and interested as they worked independently without being supervised.	Learners were making noise trying to get their bulb glowing.	Use of resources namely bulbs, cells and wires.

Lesson observations for lesson 4
Classroom observation

Date of the observation	20 August 2013
School (Pseudonym)	Ntonto Primary
Name of the teacher (Pseudonym)	Ms Ntombela
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	12h00
Lesson topic	Feedback of the lesson on plate tectonics

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	No lesson presentation took place the teacher spent the one hour period giving learners correction on the activity on plate movement.
	Is the content explained correctly?	The corrections were written on the board by the teacher, there was no explanation, and answers were taken from the textbook. The learners and the teacher had the same textbook.
	Is the teacher able to relate what he taught to real life examples?	This was not observed in this lesson.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions, questions were read from the activity and response written on the board.
Teachers' practical competency with experiments,	Did the teacher select appropriate apparatus beforehand?	No experiment was conducted in this lesson.
	Is the purpose of the experiment clearly stated?	No experiment was conducted in this lesson.
	Were apparatus checked beforehand for functionality?	No experiment was conducted in this lesson.
	Was there a worksheet or guideline on what to observe?	No experiment was conducted in this lesson.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	What was the source of the worksheet or guidelines (If any)?	No experiment was conducted in this lesson.
	Were learners clarified as to what to write on the worksheet?	No experiment was conducted in this lesson.
	Was the experiment suitable for the Senior Phase?	No experiment was conducted in this lesson.
	How was the practical work assessed or the experiment assessed?	No experiment was conducted in this lesson.
	Did learners perform hands-on practical work?	No hands-on activity was conducted.
	Did the teacher conduct practical demonstration?	This lesson focused on correction of lesson 2 activity.
	If it was a demonstration, was it visible to all the learners? Explain how	This lesson focused on correction of lesson 2 activity.
	What were the learners expected to do after seeing the demonstration?	This lesson focused on correction of lesson 2 activity.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	This lesson focused on correction of lesson 2 activity.
Pedagogical skills	Is there continuous assessment?	This lesson focused on corrections of lesson 2 activity.
	How is the classroom managed?	It was well managed.
	Does the teacher link content to learners' previous knowledge and context?	This lesson focused on correction of lesson 2 activity.
	How is the interaction of the teacher with learners?	The interaction was not bad; learners were contributing by giving responses on corrections.
	How is learner participation, are they actively involved?	Learners were actively involved by answering questions. .

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Is there evidence of cooperative learning?	This lesson focused on correction of lesson 2 activity.
	Does the teacher use models/visual examples to explain science concepts?	This lesson focused on correction of lesson 2 activity no teaching took place.
	Are the various learning styles of learners accommodated in the lesson?	This lesson focused on correction of lesson 2 activity no teaching took place.
	Is the teacher aware of learners' typical misconceptions?	This lesson focused on correction of lesson 2 activity no teaching took place.
	Does the teacher use different strategies to teach? Explain how?	This lesson focused on correction of lesson 2 activity no teaching took place.
	Does the teacher ask learners questions that cater for the different cognitive levels?	This lesson focused on correction of lesson 2 activity no teaching took place.
	How much direct teaching does the teacher use?	This lesson focused on correction of lesson 2 activity no teaching took place.
	How does the teacher use the discrepant event to clarify further for learners?	This lesson focused on corrections of lesson 2 activity no teaching took place.
Language skills	Do the planned learning activities accommodate language skills?	This lesson focused on corrections of lesson 2 activity no teaching took place.
	Does the teacher code switch appropriately	The teacher was code switching as she was writing corrections on the board.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	She displayed confidence when providing responses.
	How is the enthusiasm of the teacher?	This lesson focused on correction of lesson 2 activity no teaching took place.
	Does the teacher inspire the learners?	To allow them to participate in giving responses

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners were participating in the lesson by answering questions	Learners were interested as they gave responses.	Learners were well behaved.	Use of resources was not observed in this lesson.

Lesson observations for lesson 5
Classroom observation

Date of the observation	21 August 2013
School (Pseudonym)	Ntonto Primary
Name of the teacher (Pseudonym)	Ms Ntombela
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	12h00
Lesson topic	Compass

Checklist for the lesson observation

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
Teachers' subject knowledge	Is the content presented correctly?	The content on compass, the use of compass was presented correctly. The teacher referred to her notes as she was presenting the lesson.
	Is the content explained correctly?	The explanation of the content was done from the lesson plans the teacher has prepared.
	Is the teacher able to relate what he taught to real life examples?	She related the content on compass to being used by aeroplane and ships in the past.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	The teacher did not conduct practical work but learners were partially engaged on a practical work. The compasses were taken out of cupboard during the lesson.
	Is the purpose of the experiment clearly stated?	The purpose was not clearly spelled out.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Were apparatus checked beforehand for functionality?	No they were not checked.
	Was there a worksheet or guideline on what to observe?	There was no worksheet.
	What was the source of the worksheet or guidelines (If any)?	There was no worksheet.
	Were learners clarified as to what to write on the worksheet?	There was no worksheet.
	Was the experiment suitable for the Senior Phase?	The content on compass was suitable for Senior Phase
	How was the practical work assessed or the experiment assessed?	There was no assessment on the compass at the end of the lesson.
	Did learners perform hands-on practical work?	No learners performed hands-on-practical work except handling a compass to identify north pole as instructed by the teacher.
	Did the teacher conduct practical demonstration?	No practical demonstration was conducted by the teacher.
	If it was a demonstration, was it visible to all the learners? Explain how	No practical demonstration was conducted by the teacher.
	What were the learners expected to do after seeing the demonstration?	No practical demonstration was conducted by the teacher.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	No practical demonstration was conducted by the teacher.
Pedagogical skills	Is there continuous assessment?	Oral questions asked: What is a compass? What is it used for? How do we find the North direction in the compass?.
	How is the classroom managed?	The classroom was well managed.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Does the teacher link content to learners' previous knowledge and context?	She did not link in this lesson.
	How is the interaction of the teacher with learners?	The interaction was not bad;
	How is learner participation, are they actively involved?	Learners were actively involved in touching the compass.
	Is there evidence of cooperative learning?	There was no evidence of cooperative learning.
	Does the teacher use models/visual examples to explain science concepts?	The compass was the only visual used.
	Are the various learning styles of learners accommodated in the lesson?	The teacher was reading from her notes and lesson plan no accommodation of various learning styles was accommodated.
	Is the teacher aware of learners' typical misconceptions?	This was not evident.
	Does the teacher use different strategies to teach? Explain how?	Reading from the notes and oral questions.
	Does the teacher ask learners questions that cater for the different cognitive levels?	Only low order questions were asked.
	How much direct teaching does the teacher use?	This lesson was mainly direct teaching from her notes.
	How does the teacher use the discrepant event to clarify further for learners?	This was not evident in the lessons presented by the teacher.
Language skills	Do the planned learning activities accommodate language skills?	This was not observed.
	Does the teacher code switch appropriately	She code switch a lot.

Elements of classroom practice to be observed	Question guiding observation	Comments
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	She checked from her notes as teaching progresses and was confident.
	How is the enthusiasm of the teacher?	She was enthusiastic.
	Does the teacher inspire the learners?	Through oral questions learners were inspired.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners participated in the lesson by answering questions.	Learners were interested in the lesson when answering questions.	Learners were well behaved.	Use of resources was very minimal.

Lesson observations for lesson 6
Classroom observation

Date of the observation	22 August 2013
School (Pseudonym)	Ntonto Primary
Name of the teacher (Pseudonym)	Ms Ntombela
Subject	Natural Sciences
Grade	Grade 7
Number of learners	35
Period number and time	8h00
Lesson topic	Identifying pure substances and mixtures

Checklist for the lesson observation

Elements of classroom practice to be observed	Question guiding observation	Comments
Teachers' subject knowledge	Is the content presented correctly?	The content on pure substances and mixtures was correctly presented.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	Is the content explained correctly?	The explanation of the content was done from the textbook.
	Is the teacher able to relate what he taught to real life examples?	It was not observed in this lesson.
	Is the teacher able to respond to learners' questions correctly?	Learners did not ask questions.
Teachers' practical competence with experiments,	Did the teacher select appropriate apparatus beforehand?	No experiment was conducted in this lesson.
	Is the purpose of the experiment clearly stated?	No experiment was conducted in this lesson.
	Were apparatus checked beforehand for functionality?	No experiment was conducted in this lesson.
	Was there a worksheet or guideline on what to observe?	No experiment was conducted in this lesson and there was no worksheet.
	What was the source of the worksheet or guidelines (If any)?	No experiment was conducted in this lesson and there was no worksheet.
	Were learners clarified as to what to write on the worksheet?	No experiment was conducted in this lesson and there was no worksheet.
	Was the experiment suitable for the Senior Phase?	This is not applicable as the lesson was not a practical hands-on lesson or experiment.
	How was the practical work assessed or the experiment assessed?	No experiment was conducted in this lesson.
	Did learners perform hands-on practical work?	Learners did not conduct hands-on experiments.
	Did the teacher conduct practical demonstration?	No practical demonstration was conducted by the teacher.
	If it was a demonstration, was it visible to all the learners? Explain how	No practical demonstration was conducted by the teacher.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	What were the learners expected to do after seeing the demonstration?	No practical demonstration was conducted by the teacher.
	Were the learners assessed to find if they have learnt something from the demonstration/experiment?	No practical demonstration was conducted by the teacher.
Pedagogical skills	Is there continuous assessment?	Questions were only asked in the beginning of the lesson then at the end of the lesson the learners were given class work coming directly from the textbook.
	How is the classroom managed?	The classroom was well managed.
	Does the teacher link content to learners' previous knowledge and context?	She revised the previous lesson by asking them questions.
	How is the interaction of the teacher with learners?	The interaction was on answering the questions.
	How is learner participation, are they actively involved?	Learners were actively involved by answering questions and writing in their workbooks.
	Is there evidence of cooperative learning?	There was no evidence of cooperative learning.
	Does the teacher use models/visual examples to explain science concepts?	No visuals were used except for picture of the models of pure substances and mixtures from the textbook.
	Are the various learning styles of learners accommodated in the lesson?	Learners read notes on pure substances and mixtures from their textbooks. There were pictures modelling pure substances and mixtures.
	Is the teacher aware of learners' typical misconceptions?	This was not evident in this lesson.
	Does the teacher use different strategies to teach? Explain how?	Reading from the notes.
	Does the teacher ask learners questions that cater for the different cognitive levels?	Only recall kinds of questions were asked.

Elements of classroom practice to be observed	**Question guiding observation**	**Comments**
	How much direct teaching does the teacher use?	Direct teaching was used in this lesson.
	How does the teacher use the discrepant event to clarify further for learners?	This was not evident in the lesson.
Language skills	Do the planned learning activities accommodate language skills?	This was not evident.
	Does the teacher code appropriately	The teacher code switched.
Teachers' beliefs and attitudes in teaching science	How confident is the teacher in teaching science?	She was confident using the textbook
	How is the enthusiasm of the teacher?	She was enthusiastic.
	Does the teacher inspire the learners?	Yes through oral questions and answers attempts were made to inspire learners.

Description of Learners' behaviour			
Learners' active participation in the lesson	**Motivation and interest in the lesson**	**Learner behaviour in the class**	**Use of resources or apparatus by learners**
Learners were participating in the lesson by answering questions posed by the teacher.	Learners were interested in the lesson.	Learners were well behaved.	Use of resources was limited to the textbook.

APPENDIX 17: MS NTOMBELA DOCUMENT ANALYSIS

School (Pseudonym): Ntonto Primary School
Date collected: August to December 2013
Importance of the document: To confirm the kind of activities given to learners and the frequency
Document analysis Guide 1: Learners' daily workbooks

CRITERIA	Comments
Activities based on practical work	✓ There were activities based on practical work in the learners' books. ✓ Learners have written work according to the work schedule supplied by the district. ✓
frequency of written work	✓ Written work were 6 in January, in February 5, 2 in March, 8 in April, 13 in May, zero in June, 3 in July and 4 in August
Accuracy of feedback or corrections given to learners by the teacher;	✓ Corrections reflected in the learners' workbooks ✓ Ms Ntombela did not control by signing learners workbooks. ✓ Not all activities were marked and feedback provided.
Activities that require high order thinking;	✓ There were activities where learners described what they observed and application of information learnt. ✓ Questions of different cognitive levels were found in the learners' workbooks.
Evidence of various forms of assessment given to learners;	✓ Learners' workbooks reflected various forms of assessment from recall to interpreting information. ✓ Investigation, assignment, test and projects were reflected.

Document analysis Guide 2: Teacher documents and records (Work Schedule, lesson preparation and programme of assessment**)**

CRITERIA	Comments
Activities in teacher planning that involve practical work	✓ Work schedule reflect content where hands on activities for learners could be done. ✓ Lesson preparation reflected demonstration activities, experiments and practical tasks planned for learners.
Science content covered for the grade in the planning	✓ The planned activities reflected science content for the grade as per the work schedule supplied to the school by the district officials. ✓ There were activities planned for various cognitive levels
Learners assessment records, planned for various learning styles	✓ Programme of assessment for the year reflected the different forms of assessment. ✓ Tests, investigation, assignment and translation tasks were planned.
Recording sheets for the learner performance	✓ Learners' list reflecting names of learners with allocated marks and converted to percentages was observed in the teacher's file. ✓ Marks of learners in percentages well distributed between 20% and 70%.