Teachers' reflections of the teaching of grade 12 physical sciences CAPS in rural schools at Ceza Circuit.

By

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Declaration

I, Cedric Bheki Mpungose declare that this Dissertation contains my own work. All sources that were used or quoted have been dully referenced accordingly. This research has not been previously accepted for any degree to any and is not being currently considered for any other degree at any other university.

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As the candidates' supervisor I agree/ do not agree to the submission of this Dissertation

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Date __________________________________

Dr. Simon Bheki Khoza

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Dedication

A very warm thank you to my family who were with me through all my highs and lows during this study. To my mother, *Tryphina 'Kuteshu'* and my father *Thelelina 'sigogo sakhe, yakhala ingane, ilambile ingane ',* in your various ways of encouraging me to continue and finish this study, may God bless you. Thank you to my brothers, Bonginkosi*'bro B',* Shende *'Shakes'* and Phumuzumoya *'Sqeda'* for their huge support they made to me. To my fiancé, Andile Mthethwa, in your loving care and courage you provided, I deeply thank you. Friends and colleagues, who wished me well through this lonely journey, thank you very much.

Abstract

This dissertation presents an action research study of six teachers who reflected on their teaching of the physical science curriculum (CAPS) in South African high schools. The study adopted a critical paradigm. This study was conducted with an aim or focus to explore teachers' reflections on the teaching of grade 12 physical sciences CAPS in rural schools in Ceza Circuit, KwaZulu-Natal. As a result, reflective activity, one-on-one semi-structured interviews and focus group discussion were utilised for data generation in order explore teachers' reflections. Purposive and convenience samplings were used in selecting this specific group of teachers because I needed teachers with whom I was familiar and who were also accessible. I was also involved in the study (action research) in order to help address challenges that are faced by physical science curriculum teachers in South Africa through their implementation of CAPS. This study was framed by the concepts of curriculum spider-web in order to explore teachers' reflection of their teaching practice.

The literature reviewed teachers' reflections of their teaching practices. Findings from the literature proposed levels of teachers' reflections as technical, practical and critical level of reflections. Thus, teachers' reflections were catergorised according to these levels. Findings from the literature indicated that each curricular spider web concepts had three propositions as per level of reflections. Findings from data analysis indicated that most teachers use technical and practical level of reflection during the first phase of action research. Teachers showed much improvement during the second phase of action research because they were able to use critical level of reflection in each concept of curriculum spider web. It is found from the study that critical level of reflection may influence the smooth implementation of curriculum.

This Dissertation consequently recommends that teachers enhance all concepts of the curriculum spider-web in order to improve their teaching practice. Teachers are recommended to master the theories that underpin CAPS before teaching in order for them to understand the process intended by CAPS to improve the established curriculum. The study recommends teachers to teach and assess learners for successful achieved curriculum.

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CHAPTER 1

The overview, context and objectives

1. 1 Introduction

In the South African context, the Minister of Basic Education Department (DBE), Angie Motshekga, introduced the Curriculum and Assessment Policy Statement (CAPS) as a new curriculum intended to improve on the preceding National Curriculum Statement (NCS. Thus, Carl (2012) asserts that the implementation of a curriculum varies at the national (macro) and classroom (micro) levels, making teachers responsible for teaching/implementing the intended curriculum (such as physical science curriculum). As a result, this study intends to explore teachers' reflections on the teaching of grade 12 physical sciences CAPS in rural schools in Ceza Circuit, KwaZulu-Natal, and to ascertain what these reflections are, what informs these reflections and what can we learn from these reflections in order to improve our teaching practices. Briefly, this chapter intends to present the focus of the study, the rationale, summary of literature review, the research questions, research methods, data generation methods, data analysis, data production, limitation, delimitations, sampling and ethical issues.

1. 2 Title

Teachers' reflections of the teaching of grade 12 physical sciences CAPS in rural schools at Ceza Circuit.

1. 3 Focus and Purpose of Study

The purpose of this study is to explore teachers' reflections on the teaching of grade 12 physical sciences CAPS in rural schools in Ceza Circuit, KwaZulu-Natal.

1. 4 Location of the study (delimitation)

The study was conducted in 6 out of 11 rural high schools offering physical sciences from grade 10-12 at Ceza ward, under Mahlabathini circuit, in the Zululand district (KwaZulu-Natal). The high schools were as follows: school A, school B, school C, school D, school E and school F. All these schools offer grades 8-12, but from grades 10 to 12 they offer different streams or subject packages. What is common in all six schools is that they are located within a poor socio-economic environment and all offer physical sciences in one of their streams. Thus, they all have teachers teaching physical science in grade 12 and this then became the participant pool for the study. The study only focused on the teachers' reflections on the teaching of grade 12 physical sciences through CAPS.

1. 5 Rationale of the study

I have chosen this study because of my personal interest and involvement in the teaching of grade 12 physical sciences. I have taught physical sciences for 6 years (since 2008). I have taught physical sciences to Grade 10-12 for the last three consecutive years. Currently, I am teaching in one of rural schools at Ceza Circuit. I have observed that teachers are not aware of issues between the planned (intended) and the enacted (implemented) curriculum. This condition yields different results (attained curriculum) per school since they do not actively reflect on their practices. As a result, I have also observed a poor pass rate for physical sciences in grade 12 especially during the 2014/2015 matric results, which indicates a significant drop from the previous pass percentage. Furthermore, I have noticed that teachers repeat the same teaching activities without adaptation or change, irrespective of the changes within the curriculum. Hence, this condition has motivated me to conduct this study in order to explore teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools. For this reason, I believe that teacher's reflections may address the problem and bring alignment between planned curriculum and implemented curriculum for the positive attained curriculum.

According to Dewey (1933), reflections are regarded as processes or activities that are central to developing practices. In addition, an interpretive case study conducted by Khoza (2015a) on student teachers' reflections on their practices of CAPS highlights the importance of teachers reflection in addressing issues related to curriculum. After student-teachers reflected on their teaching practices, the study concluded that they were not aware of the theories that underpin their subjects CAPS. As a result of not understanding the theories that shape their teaching, they decided to continue with the way they had worked through their previous years of teaching. This suggests that student-teachers undertook teaching without first prioritising the implementation of their subjects. Furthermore, in the South African context, when moving from a competence curriculum (NCS) to performance curriculum (CAPS), teachers' reflections or perceptions play a vital role. As outlined in the study conducted by Msibi and Mchunu (2013), the nature of teachers' professionalism play a major role in the recent curriculum revision (CAPS). It is opined that an educational system is rooted in the historical apartheid construction of teachers which places white teachers as professionals while casting African teachers as technicians. Thus, this suggests that when teachers do not teach CAPS correctly, they may fail to regularly reflect on their teaching practice and CAPS implementation may vary in each school. In light of this, there is a need to study teachers' reflections within a critical paradigm and my study does this while also exploring how grade 12 physical sciences CAPS is implemented in rural schools at Ceza Circuit. In addition, this study reveals that those teaching Grade 12 Physical Sciences CAPS need to understand the implementation process and the theories that underpin the process in order to achieve transformation (emancipatory) intentions.

Therefore, the results of this study may help inform school administrators (circuit management, regional education officers, subject advisers, curriculum designers, and teachers) on issues surrounding the teaching of physical sciences curriculum in schools, especially those in grade 12. The results of the study may also be useful in redirecting policy makers and curriculum planners to effect positive changes in the implementation of the physical sciences curriculum.

1. 6 Literature Review

A paper written by Ndjabili (2008) looked at issues that have imposed pressure on the curriculum and assessment in the process of curriculum change. These issues included subject overload in schools, change of concepts in curriculum such as learning outcome and aims of subjects, changes in assessment methods, and the availability of teaching resources like trained or qualified educators. This paper revealed that during the apartheid era, schools were racially segregated. Ndjabili's (2008, p. 11) study revealed that "the critical determinants of effective teaching are knowledge of the subject matter, and motivation to teach and the rationale why teachers were teaching". The study concluded by outlining that the overall maintenance of any educational programme is highly dependent upon the quality of individual teachers within the classroom. This suggests that segregation of schools according to race have an influence on how teachers teach the curriculum. This clearly indicates that a learner taught by Indian, coloured, white and black teacher may not receive the same implemented curriculum of the same intended curriculum. As a result, different achieved curriculum may be attained.

Furthermore, Van den Akker, de Boer, Folmer, Kuiper, Letschert, Nieveen and Thijsa (2009) simplified the curriculum spider-web by rephrasing the concepts as questions in order for the concept to be more easily understood. The questions are as follows: Why are you teaching? (Rationale/vision), towards which goals are you teaching? (Aims/objectives), what are you teaching? (Content), how are you teaching? (Teaching activities), with what are you teaching? (Resources), how are you facilitating teaching? (Teacher role), how do you access the teaching? (Accessibility), where are you teaching? (Location), when are you teaching? (Time), and how are you assessing teaching? (Assessment). Additionally, these concepts, according to Khoza (2015a), are regarded as learning signals or e-learning signals where the curriculum spider-web rationale concepts form the central component for other teaching concepts.

1. 7 Objectives of the study

The purpose of the study is to:

A. Understand teachers' reflections of the teaching of grade 12 Physical Sciences CAPS in Ceza Circuit rural schools.

B. Explain what informs teachers' reflections of the teaching of grade 12 Physical Sciences CAPS in Ceza Circuit rural schools.

C. Explain the lessons that can be learned from teachers' reflections on the teaching of grade 12 Physical Sciences CAPS in Ceza Circuit rural schools.

1. 8 Research question

A. What are the teachers' reflections of the teaching of grade 12 Physical Sciences CAPS in Ceza Circuit rural schools?

B. What informs teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools?

C. What lessons can be learned from the teachers' reflections of the teaching of grade 12 Physical Sciences CAPS in Ceza Circuit rural schools?

1. 9 Research Design and Methodology

1.9. 1 Research paradigm

This study was framed by a critical paradigm. Critical paradigm is described as a paradigm in which a researcher aims not only to describe and understand, but also to change society in order to become more just and fair (Cohen, Manion & Morrison, 2000). This suggests that I chose this paradigm because I wanted to understand teachers' reflections on their teaching of the physical science curriculum in order to assist those teachers so that they transform their methods, through self-introspection of their teaching practices, into the new curriculum (CAPS). Christiansen, Bertram and Land (2010) also suggest that research in critical paradigm focuses on bringing change that will help those groups of people who have little power, and few opportunities or choices because of their sex, their race and their class. Given the purpose of this study and its focus in section 1.7 above, I therefore opted to use the critical paradigm as the most appropriate paradigm in this study on the assumption that within an epistemological perspective, reality is characterised by social, political, cultural economic values and history.

In fact we may all have "different beliefs or perceptions, but ultimately, there is only one reality and one truth" (Christiansen et al., 2010. p. 28). Since the research findings from the critical paradigm are subjective and are not replicable (the results would be different if the same study was done in a different context). This suggests that the findings of this study exposed social injustice via transformation of the participants' context in their teaching of the curriculum. As a result, the results of this study cannot be generalised but other teachers may refer to findings and recommendations. The rationale for using this paradigm in this study is that none of the other previous studies described in the literature used this paradigm and this suggests a gap in the literature that needs to be attended to.

1.9. 2 Research approach/style

The study adopted a qualitative approach which allows me, as the researcher, an opportunity to try to understand and describe the ways in which different individuals make subjective sense of their lives. This approach also attempted to gain an in-depth understanding by asking questions that not only inform the researcher but also stimulate the participants to reflect on why they engage in particular activities (Mouton, 1996). According to Creswell (2012), qualitative researchers deal with socially constructed realities and qualities that are complex. Their task, therefore, is "to attempt to describe, understand and interpret how various participants in a social setting construct the world around them" (Merriam, 2002, p. 29). Babbie (2004) also asserts that the aim of qualitative research is to promote better self – understanding (transformation) and to increase insight into the human condition. Thus, this suggest that the qualitative approach is appropriate for this study because it has given me the opportunity to understand and interpret the grade 12 physical science teachers' lived experiences (currere) in order for them to undergo an emancipatory process in their teaching practices. This approach offered the possibility of a collaborative partnership between myself and teachers, and also sought to engage teachers in a reflective practice of teaching physical sciences in grade 12.

Furthermore, this study used the action research qualitative approach in the critical paradigm. As defined by Maree (2007), action research is a type of research that encourages a collaborative or participative approach to finding solutions to practical problems experienced by participants. Furthermore, in this action research, I acted as a mediator in order to help participants plan and implement an intervention that ought to alleviate the problem experienced in teaching of Grade 12 Physical Science CAPS. I also assisted teachers to evaluate and assess the effectiveness of an intervention so that participants (teachers) can reflect on the process. Christiansen et al. (2010) reveal that action research in education assumes that teachers know best what is happening in their classrooms. Therefore in this study, I considered teachers as the best participants to participate in this study so that they can reflect on the teaching of Grade 12 Physical Science curriculum. Teachers participated in finding solutions for problems that they experienced in their classrooms. Thus, transformation and emancipation occurred in order to improve teachers' practice of their teaching. One of the drawbacks of action research is that, it cannot be done by anyone.

In overcoming this drawback, I ensured that this action research is “done by particular people on their own work” (Christiansen et al, 2010, p. 40). As result, only those who taught Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools were eligible to participate in this study. Getting further, Lisle (2010) and McNif and Whitehead (2009) believe that action research is subjective but in-depth, open-ended, exploratory and transformative in nature and it is conducted on entities in their natural settings. As a result, I opted for action research in order to allow teachers to make inquiries of their teaching practices with the aim of improving their teaching situation. Action research was significant for this study because it was more transformable, holistic, explorative and contextual in its nature and it was aimed at improving teachers’ practices through their reflections.

1.9. 3 Sampling

Sampling is described by Christiansen et al. (2010) as making decisions about which people, setting, events or behaviors to observe or study. Kerlinger (1964) reveal that sampling is referred to as process of choosing a smaller, more manageable number of participants to take part in the research. Factors such as expense, time and accessibility often prevent researchers from using the entire population to gain information needed, therefore a small group or a sub-set of the population is used in such a way that it will be representative of the whole group. Thus, in this study, I used a purposive sampling in order to include teachers with whom I am familiar with and who were from the same environment (Ceza) as mine. However, sampling is also convenient because I chose teachers who would be easily accessible and available since I teach with them. In cases where there were two teachers per school, I selected the senior teacher among them. I have opted to include senior teachers because they have been in the system through the curriculum change from NCS to CAPS. I anticipated that these teachers were mature and less likely to be resistant to my study and would not leave the study since they were experienced and committed.

1. 10 Data generation methods

The study adopted three techniques in data generation/production, namely an open ended questionnaire for participants’ reflective activity, one-on-one semi-structured interviews and focus group semi-structured discussion.

1.10.1 Reflective activity

Cohen et al. (2011) describes the "Teacher Reflective Activity" as a written activity that asks teachers to complete a short series of questions about the issue studied. In this study, I designed an open-ended questionnaire as a reflective activity that is guided by curriculum spider-web for the six teachers to complete so as to provide the foundation for our focus group discussion. Cohen et al. (2011) reveal that a researcher designs and provides a questionnaire to participant with the expectation that they will be honest in their responses. This suggests that it is not easy to ensure honesty from participants' response. In overcoming this, I provided enough time for the participants to complete questionnaires and also put more emphases on the issue of honesty in their reflections. I collected questionnaires from participants three days before interviews or group discussions so that I could evaluate their answers and shape the face-to-face discussions better.

1.10.2 Focus group discussion

Cohen et al. (2011) states that, in focus group interviews the researcher facilitates group discussions by actively encouraging group members to interact with one another. Drawing from this, I conducted a focus group discussion at one of the schools that is central to all six participants. The group discussion focused on reflecting of the teaching of grade 12 physical sciences CAPS. I directed the discussion in such a way that I provided space for participation. As a result, both me and teachers found from reflections the solutions on how we could tackle challenges we faced during the implementation of the physical science CAPS. Furthermore, I actively facilitated one semi-structured focus group interview (discussion) using the same kind of questions asked in the questionnaire in order to avoid only one voice being heard. Cohen et al. (2011) believe that status differentials are one of the drawbacks of a focus group discussion, but this was avoided by ensuring that all teachers were the same status, they were all in post level one of employment category.

1.10.3 One-on-one (individual) semi-structured interviews

McMillan and Schumacher (2006) define interviews as open response questions that elicit participants' meanings in order to make sense of important events in their lives. "It does allow for the probing and clarifications of answers and it usually requires participants to answer a set of predetermined questions" (Maree, 2007, p. 87). I found one-on-one (individual) semi-structured interviews to be the most suitable for this study because it allowed participants to give more detailed responses based on the very same set of questions asked during reflective activity and focus group discussion. I was friendly with the six participants during interviews in order to allow flexibility in their responses. I gave each interviewee the freedom to relax which yielded more information as I probed their responses. Even though Christiansen et al. (2010, p. 68) assert that, "interviews generate large amounts of textual data such that when one transcribe, a 45 minute interview it can become a 15 pages of text". Thus in this study, in overcoming the drawback of time and length of textual date, I conducted interviews for a duration of approximately 30 minutes per session. Interviews were not transcribed but were recorded using a cell phone, which I later analysed data directly from the recorded source. I also held interviews during break times or after school, depending on the needs of each participant.

1. 11 Data analysis

Cohen et al. (2011) defines qualitative data analysis as creating sense of data in terms of the participants' definitions of the situation, noting patterns, themes, categories and regularities. For the purposes of data analysis, I included three vital questions: what does the data say and how is it interpreted? What does the data mean? And how can the data are presented through analysis to the readers? Thus, I adopted guided analysis which included both inductive and deductive reasoning processes. Guided analysis refers to the predetermined categories of the theory of curriculum spider- web (Van der Akker et al, 2009). It is this theory that underpins the deductive coding of the data. On the one hand, I enhanced inductive reasoning by ensuring that the categories emerged from the data, while on the other hand, I started with a set of categories, which were then mapped onto the data for the purpose of deductive reasoning. Furthermore, I utilised an open coding which is defined by Cohen et al. (2011) as the simple new label that a researcher attaches to a piece of text to describe and categorise that piece of text. Thus, I used guided analysis to code participants' responses from the recorded source in order to reveal the focus of the study; the exploration of teachers' reflections on the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools.

1. 12 Ethical clearance

Ethics is defined by Cohen et al. (2000) as a matter of principled sensitivity to the rights of others, and that, while truth is good, respect for human dignity is better. Furthermore Christiansen et al. (2010) also outline that ethics in research is vital, especially when it comes to research involving humans and animals because all research studies must take into account the rights of participants to be protected from any harm that might be caused by the research. Further to this, Cohen et al. (2011) clarify that ethics are situated which implies that they have to be interpreted in a specific local situation. Thus, in this study I sought permission to conduct the research by writing to the Department of Education at the Mahlabathini circuit in the Zululand region. After permission was granted, I contacted the participants in writing and telephonically to ask their permission to participate in the research study.

Furthermore, Cohen et al. (2011) emphasize the ethical principles of autonomy, non-malfeasance and beneficence. Thus, after participants had agreed to take part in the study; I briefly explained the purpose of the study which is to explore teachers' reflections on the teaching of grade 12 physical sciences in rural schools at Ceza Circuit. I informed all participants in writing and verbally of their rights to confidentiality, anonymity and about their voluntary participation. I made them aware that they were free to withdraw consent and participation at any time. I ensured their rights to privacy by using pseudonyms instead of their real names and I made them aware that any information they provided will be confidential. In addition, I assured them, for the sake of honesty and transparency, that their information would only be used in this study and not for any other irrelevant purposes. I also informed each participant that study was beneficial to them (beneficence) and that the study will do them no harm (non-maleficence). Following this, participants committed to the process by signing consent forms.

1. 13 Trustworthiness

The term trustworthiness refers to the way in which the enquirer is able to persuade the audience that the findings in the study are worth paying attention to and that research is of a high quality (Lincoln & Guba, 1994). Furthermore, Lincoln and Guba (1994) reveal that paying attention to the following dimensions will increase trustworthiness in a qualitative study: credibility, transferability, dependability and conformability. Therefore I ensured the trustworthiness of the study by ensuring that the above stated dimensions are adhered to. Cohen at al. (2011) and Christiansen et al. (2010) describe transferability as applicability of the research findings to another context. Thus, in this study, I enhanced transferability by ensuring that the accurate findings of the study from the study (teachers' reflections on the teaching of Grade 12 Physical Sciences in Ceza Circuit rural schools) were beneficial or were applicable to other teachers who were not involved but who were in another context similar to this.

Furthermore, dependability is about providing correct and direct information in the study, thus I offered concise evidence of data generated in this action research by including direct quotations to allow readers to assess the findings for themselves. In addition to that I also used cell phones to record interviews in order to ensure dependability of this study. In addition, the process of conformability is concerned with whether the findings reflect the experiences and ideas of the participants (Shenton, 2004). According to Cohen et al. (2011), for a research to be trustworthy the findings will be confirmed by participants as true reflections of their responses and as a researcher I must acknowledge any bias and circumstances that may affect the data in any way. As a result, I therefore acknowledged that I did not use my power to influence the findings to ensure coherence and consistency. In addition, Lincoln and Guba (1994) describe credibility as the findings reflecting the 'reality' and lived experiences of the participants and for a research to be trustworthy, it must demonstrate that if it was carried out in a similar context then similar result would be found. Thus, this study ensured that all participants had the same questionnaire and I posed the same questions at interviews and I conducted all interviews within the school context so that teachers could reflect on their reality and lived experience of teaching science in grade 12 within the environment in which they operate.

1. 14 Anticipated Problems/Limitations

Due to the fact that I am a Grade 12 Physical Sciences teacher within the same ward (Ceza), I was careful to avoid being bias and having a personal interest while conducting of this study. However, I did not raise any opinions, knowledge and experiences that I had about the study. In order to overcome this, I therefore allowed the participants to provide their own data without being influential to them during our interview process. One of the limitations, like all other qualitative research, is that this study is small scaled and thus its findings and results are subjective, personal and contextual and therefore cannot be generalized. Thus, the findings of this study can be used only for the sake of transferability rather than generalisation.

1. 15 Chapter overview

1. 15.1 Chapter 1

This chapter seeks to provide the reader with the general background of the study. This chapter also shows the title, the focus, research objectives and research questions of the study as well as the location of the study. Chapter one indicates the rationale of the study; outlines my personal reasons for undertaking the study; what the literature says about the study phenomenon (teachers' reflections) and study focus (teaching of physical science); as well as the significance of the study. In addition, this chapter looks at a brief literature review where the 10 concepts of curriculum spider-web were outlined (Van den Akker et al, 2009). Chapter One also highlights the research design and methodology.

1. 15.2 Chapter 2

This chapter provides the reader with the reviewed literature on four areas related to the study: teacher's reflections, curriculum presentation (intended curriculum, implemented curriculum and achieved curriculum), competence curriculum versus performance curriculum, and curricular spider-web concepts (conceptual framework).

1. 15.3 Chapter 3

Chapter Three provides details on the methodology adopted by this study in order to achieve research objectives. The chapter indicates the adopted research design approach (critical paradigm). This chapter outlined the participants (six teachers) and research methods (reflective activity, one-on-one semi-structured interviews and a focus group discussion). This chapter also describes sampling (convenience and purposive sampling), trustworthiness (credibility, transferability, dependability and conformability), guided analysis (inductive and deductive reasoning), ethical issues and the limitations of the study.

1. 15.4 Chapter 4

This chapter presents analyses and discusses the findings from teachers' accounts generated in action research. This chapter displays how guided analysis is used to follow the ten concepts of the curricular spider-web. Chapter Four also shows how concepts are developed into themes which then form categories that are aligned with the three levels of reflections (technical, practical and critical). These categories ensure that the voices of the teachers are adhered to.

1. 15.5 Chapter 5

This chapter looks again at the overall purpose of this study and evaluates if the findings in the previous chapter effectively address the study's purpose. The research findings are summarised related to the study's purpose and to the specific research questions. The questions ask: what are the teachers' reflections? Why teachers reflect the particular way? And what lesson can be learnt from their reflections? Conclusions from this study are derived and linked to these research questions which are then used to achieve the study purpose. The study purpose is to understand teachers' reflections, explain what informs teachers' reflections and explain the lessons that can be learnt from reflections. Finally, relevant and prolific recommendations are made in this chapter, including the suggestion for further research.

CHAPTER 2

<u>The review of the literature</u>

2. 1 Introduction

This chapter will present the review of the literature as based on the research phenomenon (teachers' reflections) and other key concepts and matters related to curriculum (intended, implemented and achieved curriculum, competence versus performance curriculum and concepts of the curricular spider-web). Literature review clarifies the key concepts, terms and the meanings for the research and also establishes the context for the research (Cohen, Manion & Morrison, 2007). Furthermore, Silverman (2013) reveals that the literature review states points of convergence and divergence between your study and earlier studies and also allows you to make claims later in the study. Hence, this chapter attempts to explore teachers' reflections on the teaching of Grade 12 physical sciences curriculum and assessment policy (CAPS). This chapter intends to understand teachers' reflections, explain what inform teachers' reflections and the lessons that can be learnt from the teachers' reflections.

In addition to the above, this chapter reviews the literature related to both the research objectives and research questions covering the reflections of teachers in teaching/implementing the physical science curriculum. This chapter intends to start by defining key concepts to be utilised in study. The curricular spider-web as a conceptual framework adopted for this study will also be explored as it will provide themes for reviewing literature for this research. The concepts of the curricular spider-web assist to find relevant studies on the teaching of physical science CAPS and address the research questions of this study. In short, the key concepts that frame this study are concepts of curricular spider-web that form the conceptual framework for this study. Figure 2.1 includes the Chapter 2 flow chart with vital details of the literature review.

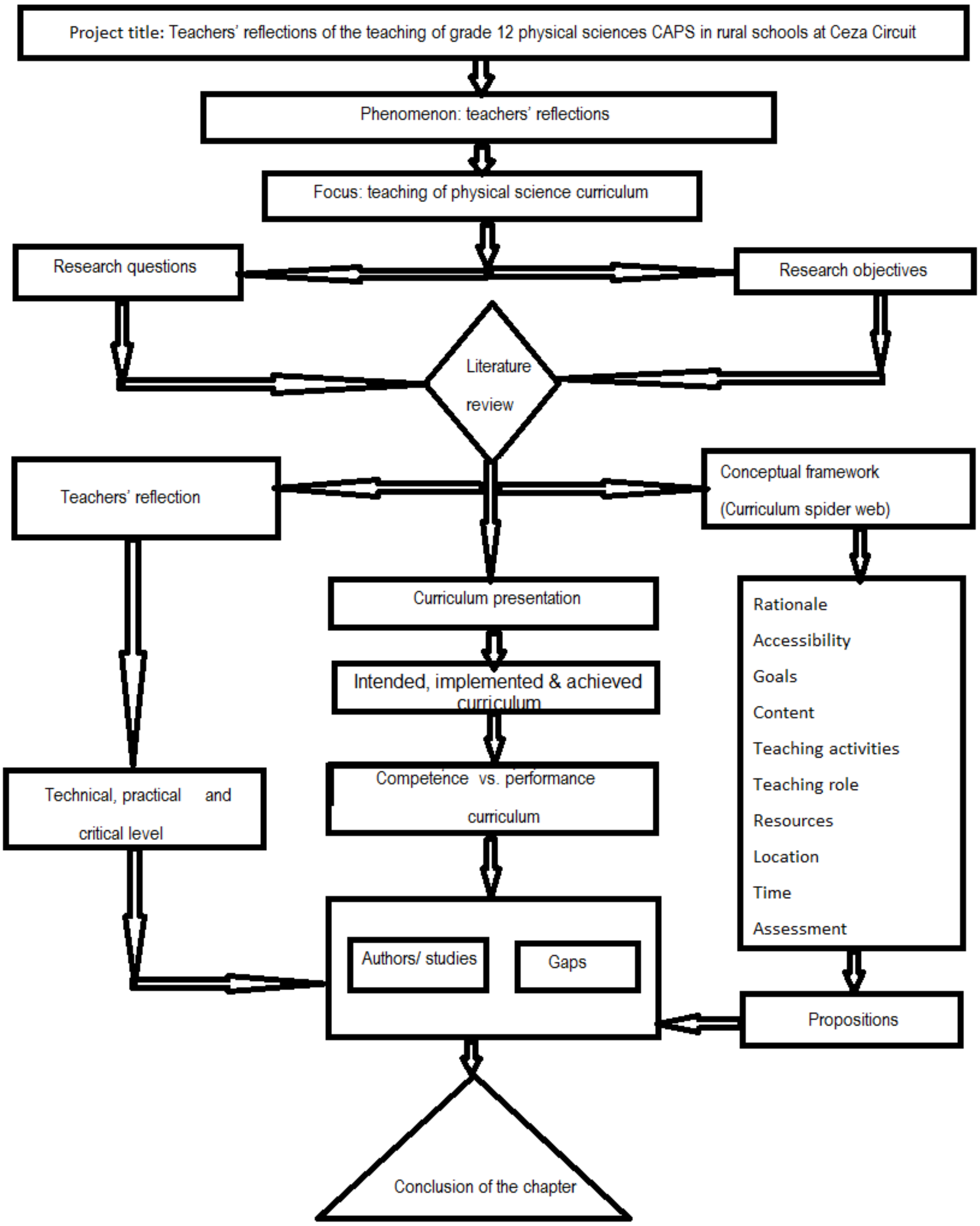

Figure 2.1: Chapter 2 flow chart

2. 2 Phenomenon (teachers' reflections)

Reflections play a major role in the teaching/implementation of the intended curriculum. Leitch and Day (2000) reveal that although reflections hold meanings of thinking processes and contemplative self-examination but reflection is associated more with acts of understanding that are linked to learning 'how' rather than learning 'what'. According to Dewey (1933) reflections are regarded as a process or activity that is central to developing practices. This suggests that, reflection represent the process of teachers' introspection by learning from their experience of teaching for emancipatory purposes. Reflections help teachers to understand and "have control over the content and processes of their own work" (Zeichner & Liston, 1987, p. 26). Thus, in the name of reflection many teachers are encouraged to think critically of their own practice.

Most importantly, "reflection helps the individual to learn from experience because of the meaningful nature of the inquiry into that experience and reflection also involves working toward a better understanding of the problem and ways of solving it" (Loughran, 1996, p. 14). Dewey (1933) sees the concept of reflective practice as important in the curriculum because reflection precedes intelligent action, a reflective thinking in Dewey's (1933) view generally addresses practical problems, allowing for doubt and perplexity before possible solutions are reached. Dewey's (1933) idea of reflective practice is in line with Killen (1989) of becoming a reflective teacher. Killen (1989) outline that there is always a room for improvement in any teaching practices no matter how perfect teachers might be. This suggests that reflective teaching practice can help teachers on how and why they teach the physical science curriculum. Killen (2007) goes a step further by revealing that through reflection teachers should look back on how they teach, what they teach and why they teach in a certain way.

Furthermore, van Manen (1991) outlines various forms that reflection can take: retrospective reflection is based on past actions; anticipatory reflection is devoted to future actions; and contemporaneous reflection is reflection in action. This suggests that teachers may be involved in all kinds of reflections in their reflective teaching practice. Schon (1983), outlines that reflection is a purposeful, systematic inquiry into practice, which suggests that teachers may be engaged in various reflective activities in order for them to reflect on issues of their curriculum. As van Manen (1991) believes that, reflections have the potential to engage teachers in a critique of their beliefs and practices during the teaching and learning process of their curriculum and as a result the reflective process can help teachers to transform.

Furthermore, Schon (1987) concur with van Manen (1991) by introducing the concept of frame (view based on the knowledge used by teachers to interpret their context) in reflection such that conceptual (what teachers think) and action (what teachers do) frame the reflective practice of teachers. Schon (1987) further suggest that conceptual and action frameworks form the bases of reflection-on-action (look at the past to shape the future) and reflection-in-action (occurs during the teaching process). Similarly, Zeichner and Liston (1987) opine that both reflection-on-action and reflection-in-action depend on the depth of reflection and nature of those things that teachers reflect on. This suggests that reflective teaching practice for teachers, in teaching/implementing the curriculum, depends on their past actions, current context and the future intentions.

Furthermore, the importance of teacher reflections is highlighted by Pedro's (2005) qualitative interpretive case study which was conducted on five pre-service teachers with their own comprehension of reflective practices as informed by their teaching practice. The study concludes that reflection is a process where you are acting in certain ways things are happening to you, it poses questions to you about how you can change or what you need to do in order to change. As a result, this concurs with Dewey's (1933) and Schon's (1983) notion of reflection as a problem-solving tool. This suggests the ability of teachers to look back critically and imaginatively to do analysis, and also to look forward and undertake emancipatory planning in order to transform. In other words, this suggests that teachers are to involve themselves in introspection; connect with other skilled teachers on identified problems that are affecting their teaching practices; and also record their teaching to inform or change their future practices in their curriculum. Pedro's (2005) findings are in line with that of an interpretive qualitative study conducted by Orland-Barak and Yinon (2007) which reveals the importance of teacher reflections. The studies conclude that teacher's reflections assist student teachers to find the connection between their theory and practice during their teaching practice, and that it helps teachers to develop grounded theories of practice.

In addition to the above, Killen (1989), Zeichner and Liston (1987), assert that teacher reflections help teachers to maintain good relationships with learners; teachers ensure a high level of job satisfaction. Teachers can also talk about their experiences and improve their teaching practices. This suggests that reflective teachers maximize learning from their teaching practices for their own professional development. As a result, teachers can use various methods to reflect of curriculum implementation, such as involving themselves in an action research in the teaching of the physical science curriculum.

However, according to Hatton and Smith (1995), the practicality of reflective practice is not possible if people in action are resistant to change and are not participating on reflective activities. In other words, this suggests that teachers' reflections cannot be possible if teachers are resistant to any change in curriculum and if they do not participate in any planned reflective activities. This is in line with Pedro (2005) who concludes that one shortcoming of reflection is that it depends on the reflection of other significant people. This suggests that reflection needs to be encouraged by others. As a result, for teachers to reflect on the teaching of the physical science curriculum they need others like subject advisers, researchers, HODs and principals to make them see the need to reflect on their teaching practice. In other words, teachers themselves should actively participate in reflective activities for emancipatory purposes.

However, Schon (1983) brings in the concept of a reflective practitioner as the one who thinks on teaching and responds to all situations that arise in teacher reflection. This suggests that reflections enhance teachers in ways that challenge the existing teaching practices in physical science curriculum in order to bring about alternative solutions. Furthermore, a case study conducted by Kehdinga (2014a) asserts the importance of personal elements, social elements and political elements in any successful reflection of curriculum because it encourages the theorising processes. Hoadley and Jansen (2013) also believe that in addition to elements stated by Kehdinga (2014), pedagogy/specialised knowledge elements play a vital role when teachers reflect on their teaching practices. However, van Manen (1977) displays three levels of reflections in the reflection of curriculum that should be used by teachers: technical level of reflection, practical level of reflection and critical level of reflections.

Furthermore, van Manen (1977), as well as Zeichner and Liston (1987) assert that at the technical level of reflections teacher deal with technical application of educational knowledge in a learning environment so that it would be easy to achieve learning outcomes. This level of reflection encourages school knowledge (research-based knowledge). This suggests that teachers in this level are encouraged to reflect on the type of approach that the curriculum adopts. In this level of reflection performance approach to curriculum supports school knowledge and as a result those teaching physical science should reflect on learners, teaching methodology, assessment and the learning space. Furthermore, Zeichner and Liston (1987) assert that this level of reflection encourages teachers to reflect by using educational criteria for reflection where teachers look at the situational or institutional context. This suggests that in order to achieve learning outcomes, those that teach physical science should reflect on the local context and the school environment, including the availability of teaching resources like, soft-ware, hard-ware and ideological–ware resources.

In addition to the above studies, ideas on teachers' reflections are in line with the idea that teachers' reflections can be influenced by pedagogy. As Hoadley and Jansen (2013) assert, pedagogy involves the relationship between a teacher and learner since they all learn from each other during the implementation process of the intended curriculum. Pedagogy has to do with text (putting text), space (particular space) and time (specific time). In other words, teacher reflections have to do with the teaching role (teacher-centred, learner-centred and content-centred) of the physical science teacher as a specialised activity which requires demarcated space, time and specialised knowledge (content knowledge). Further to this, "curriculum use is linked to teachers' knowledge" (Houdley & Jansen, 2013, p. 134). In this case, teachers' knowledge of physical science is a vital resource needed in order to teach physical science. In other words, this suggests that the way teachers teach physical science, whether teacher-centred, learner-centred or content is centred, would determine their role during the implementation process. This is evident when Khoza (2015a) concludes from his case study that these three approaches/theories (teacher-centred, content-centred and learner-centred) are important when teachers choose a relevant approach to position their teaching role during their reflections in the classroom context.

According to van Manen (1977) as well as Zeichner and Liston (1987) in practical level of reflection teachers are concerned with the principles that guide their teaching practices. In this level teachers are concerned with the aims and objectives to be attained. Schon's (1983) concept of reflection concur with that of Zeichner and Liston (1987) when asserting that technical criteria in this level of reflection is vital because teachers are encouraged to use their previously acquired knowledge in order to achieve the goals of the intended curriculum. This suggests that in this level of reflection, teachers should reflect on the teaching guidelines from the intended curriculum. In addition to the above, reflection can be influenced by political dimensions, "the planned or intended curriculum also relates to the political dimension of schooling" (Kehdinga, 2014a, p. 127). Similarly, Apple (2003) portrayed that the curriculum is a political document and education is also political in the manner that is constructed. In other words, this suggests that educational or intended curriculum aims and objectives are designed to meet the vision of a political ruling party, including that the nature of the textbooks used and all stakeholders are political in nature. As a result, physical science teachers should be aware that their reflections could be also political since curriculum is a government philosophy as are the aims and objectives that need to be achieved. Pedro (2005) agrees with Britzman (1991) that teaching is a time when one's past, present and future are set in dynamic tension which yields from teachers' reflections that can be from political point of view. Thus, this suggests that political teacher's reflections are also based on educational theory that they had learned or experienced in their university courses as they progressed through the teaching profession.

Van Manen (1977) as well as Zeichner and Liston (1987) assert that in the critical level of reflection teachers are concerned with external factors from the classroom teaching practice that can inform their reflections which includes social issues such as equity and emancipation. They take it a step further in revealing that for any critical level of reflection to be successful, teachers need to reflect on two purposes: understanding the power and relationship in teaching; and understanding the assumption and teaching practices. Zeichner and Liston (1987) further assert that teachers in this level should use the critical criteria which encourage teachers to reflect upon the ethical and moral aspects of teaching.

In addition to the above, the ethical and moral aspect of teaching involves the importance of the personal element in teacher reflection. This occurs when implementing any curriculum. See the study conducted by Taole (2013) with the purpose of exploring teachers' reflection of curriculum review within the context of educational change in South Africa. The study concludes that teachers are change agents in the curriculum review process as they are the curriculum implementers and those teachers' conceptions and ethical aspect in curriculum will determine the success or failure of any curriculum evaluation. This suggests that ethical, moral and personal qualities play a vital role when teachers reflect on the teaching of any curriculum. The study concluded that some teachers teach because they have passion and as professionals, they enjoy and feel happy when teaching their subjects. Thus, this may enhance teachers to achieve goals and aims stated by the Department of Basic Education as intended by the curriculum. Furthermore, a case study conducted by Pedro (2005) used observation as a data collection method: from participant observation, the pre-service teachers observed that the process of reflection was socially determined because their understanding of reflection and learning to reflect is based on what their professors taught them in their various courses. This suggests that teachers' reflection of the teaching of physical sciences should also be based on social construction in order to ensure change, such that teachers should be aware of the stakeholders (lead teachers, subject advisers, etc.) that play a major role in the teaching of the physical sciences curriculum. This is evident when Blumer (1969) as well as Zeichner and Liston (1987) conclude that reflection is a social phenomenon that results from the interpretation of input from others, rather than individual themselves.

Furthermore, a case study by Kehdinga (2014a) concurs with findings by Pedro (2005) because the study concludes that the intended curriculum also shares the social dimension of schooling since students are part of society. This is similar to Decker's (2002) input that the teaching and learning process is from the nature of the society and the curriculum. Teachers' individualized theorising can reflect the specific needs of the student and also the general needs of the society. Additionally, Khoza (2013b) adds more on external issues from the school context, when he argues that the intended curriculum is seen as a remedy for society's economic growth, and social and developmental needs. As a result, for those teaching the physical science curriculum their reflections should meet the social needs of the society in which they are teaching in order to help them to transform. Thus, in the South African context, the South African government intended curriculum (CAPS) aims at producing a better citizenry via teaching and learning the curriculum. Aims relates curriculum to the social dimension.

Furthermore, in the discussions from the reviewed literature, most studies are conducted in interpretive paradigm as case studies. This suggests a need for a study to be conducted using the critical paradigm via action research style so as to involve teachers in the research in order for teachers to reflect of their teaching practices so that they may understand curriculum teaching/implementation. Studies used observation and interviews as the data generation method in order for teachers to reflect, but only one study from the literature used the reflective activity for data generation. This indicates that more studies should be conducted with the reflectivity activity in order to fully explore all dimensions of teachers' relationship with the curriculum. None of the above studies have explored Grade 12 teachers' reflections on the teaching of the physical science curriculum. Therefore, there is a need to conduct this study in order to bridge the gap in the field of curriculum studies based of teachers' reflections.

2. 3 Curriculum presentation (Intended curriculum, implemented curriculum and achieved curriculum)

Hoadley and Jansen (2013) and Pinar (2004) explain that the word curriculum originates from the Latin word 'currere' which implies to conduct a course for learning. Furthermore, Hoadley and Jansen (2013) assert that curriculum can be defined in three different dimensions: curriculum as intended; curriculum as implemented; and curriculum as achieved. Curriculum is what is planned, intended or prescribed to be taught and it can be called "curriculum as-a-plan" (Hoadley & Jansen, 2013. p. 9). However, the word curriculum, in short, is defined as a "plan for learning" which is also termed as a syllabus (Van den Akker et al., 2009, p. 9). Thus, the word curriculum and syllabus are used interchangeable. Further to this enacted curriculum is concerned with what teachers and learners practice in the planned curriculum. Implemented curriculum, or curriculum as experienced, is also called curriculum-in-practice which "emphasises the teachers' role to interpret the curriculum" (Hoadley & Jansen 2013, p. 37). Similarly, Pinar (2004) defines curriculum during the teaching/implementation of curriculum. Pinar (2004) reveal teachers' infinitive autobiographical nature of their lived experiences (reflections) in defining curriculum which in turn becomes a 'plan of learning'. This suggests that, Pinar's (2004) definition of curriculum will enable teachers to reflect on the implementation of the physical science curriculum.

Furthermore, assessment is concerned with the measurement of how learners perceived the achieved curriculum as planned from the official curriculum. Thus, it might be difficult for all learners to equally receive the achieved curriculum, but, Hoadley and Jansen (2013) outline that the achieved curriculum “provides feedback and make input for both intended and an enacted curriculum”. As a result, for teachers to understand this dimension they need to always reflect of their teaching practice during the teaching process.

Moreover, Talla (2012) take the intended curriculum as a plan of action or a written document that involves methods for achieving educational aims and objectives. This plan of action can cut across all levels of curriculum with each level having to do with planning for effective implementation. Van den Akker et al. (2009) further believe that Tyler (1959) was one of the first curriculum thinkers to reflect on strategies for systematic curriculum developments and Tyler’s approach provided a clear step-by-step plan in developing and evaluating the curriculum. In addition, Hoadley and Jansen (2013) also suggest that Tyler (1959) is regarded as the father of what has become known as objective or product approach to curriculum plan. Hoadley and Jansen (2013) explanations are in line with inputs made from the case study by Graham-Jolly (2003) in understanding the nature of curriculum. Graham-Jolly (2003) asserts that in the South African context, curriculum is often used to refer to the school academic programme which reflects subjects in a form of a syllabus. Subjects include the total prescribed content of a particular phase or a grade and all the activities to be taught by a teacher.

Further to the above, Stenhouse (1975) sees curriculum as intention, plan or prescription where all intended content to be taught is prescribed. Thus, this suggest that those teaching the physical science subject should be able to reflect on the physical science curriculum plans which will then assist them in their teaching. The concepts of curriculum stated above suggest that those teaching the physical science curriculum should have a clear understanding of the prescribed, planned or intended content in their school from the Department of Basic

Education so that they should know what is to be taught. Furthermore, Chislom (2004) concludes that the intended 2005 South African curriculum context is in line with an outcome-based approach which attempts to improve the quality of the learning experience through methods that emphasise activity-based, rather than rote, teaching and learning process. In the South African context, this suggests that it is a responsibility of physical sciences teachers to be aware, to interpret and to reflect on the official curriculum with its approaches. Curriculum is planned and documented in one document called CAPS which is now in use and common in all South African schools for proper implementation. Curriculum implementation (implemented curriculum) refers to the actual use of a syllabus or what it consists of in practice (Marsh, 1998). This suggests that the implemented curriculum takes place when teachers teach/implement the intended curriculum during the teaching and learning process in the classroom.

Furthermore, Fullan (1989) also affirms that implementation of a curriculum involves new behaviours, practices and theories, beliefs, and understandings. This suggests that implementation therefore involves changes and transformation in what teachers know and it calls for teachers to reflect of their teaching in physical science curriculum. In addition, Hoadley and Jansen (2013) believe that the enacted curriculum includes how teachers and learners put curriculum into practice and that it is not possible for teachers to implement the intended curriculum exactly the same way as prescribed. This suggests that teacher’s reflections may play a major role for teachers to reflect on their teaching. Reflection assists teachers to come up with their own thousand theories of curriculum implementation (Kedinga, 2014a). In this respect, teacher’s interpretations and implementation of curriculum at micro-level may vary due to various reasons, which might leave a gap between the intended and implemented curriculum. In fact, in the physical science curriculum teachers need to transform intended curriculum into implemented curriculum. Transformation period is experienced by learners at Nano-level.

In addition to the above, Hoadley and Jansen (2013) indicate that the intended curriculum is not contained in one document but comes in various documents that outlines the content for learning areas and subjects. These documents apply to the different levels of the curriculum. This suggests that in the implementation of Grade 12 physical sciences syllabus, teachers should be aware of annual teaching plans (work schedules), lesson plans and textbooks, which are all curriculum documents. In addition, Hoadley and Jansen (2013) raise the concern that both the intended (curriculum as plan) and the implemented curriculum (curriculum as practice) need to be considered during the teaching and learning process. This suggests that, the consideration will enhance the proper implementation of the physical science syllabus. Jansen (2013) acknowledges the complexity of curriculum implementation by stating that both curriculum as a product and curriculum as a process needs to be considered in order to balance the product and the practice so that learners should well receive the learned or assessed curriculum. This will close the gap between intended and implemented curriculum.

Hoadley and Jansen (2013) clearly state that what is set out in the intended curriculum needs to be assessed or tested. This suggests that teachers should be aware of the assessed/attained/achieved curriculum which includes different types of assessments. In other words, the achieved curriculum is aimed at setting the levels at which the planned curriculum should be taught by teachers. The report by Department of Basic Education -DBE (2009) asserts that assessment plays a major role in relation to curriculum and learning. Assessment allows teachers to measure learner's progress and assessment is done for remedial purposes. Assessment measures the quality of intended and implemented curriculum in order to assess the consistency of curriculum at both national and school level. The report further outlines that the achieved curriculum holds teachers accountable for student learning. This suggests that, teachers teaching the physical science curriculum are responsible for ensuring that the intended content is taught in order to assess learners based on relevant content. Thus, if learners pass what is being assessed, then good results of learners ensure that curriculum is achieved positively.

Furthermore, when looking at the South African context, those teaching Physical Science CAPS should be aware of assessment requirements as stipulated in CAPS documents so that they should know what to teach, at what level, and how to ensure that learning has been achieved. As a result, teachers should account for a failure rate in a subject. For instance**,** DBE (2014) announced that there is a drop in pass percentage of physical sciences in the year 2014 matric results both nationally and provincially. In this case, it indicates that teachers should be held accountable and be able to explain why there is such a high failure rate since they are the ones who implement the physical science CAPS. This also suggests that there may be many factors which can lead to high failure rate of physical science in school such as poor conceptualisation of the intended and implemented curricula by teachers. The habitus and personal dispositions of teachers, poor teacher training which yields incompetent teachers, a misfit between teachers and subject, a misfit between students and the subject/teacher/context may also yield to poor results (NEPI, 1993).

In addition to the above, the qualitative case study conducted by Kehdinga (2014a) on six university students of Kwa-Zulu Natal with the purpose of exploring the concepts of thousand theories on the implementation of the curriculum. Semi-structured interviews were used to generate data and purposive sampling was used in selecting samples. Kehdinga (2014a) concurs with Cuban (1992) in defining what achieved curriculum is, by revealing that the achieved curriculum refers to what students practically learn in classrooms and also deals with the notions and ideas that students truly learn and remember what teachers have taught them. Jansen (2002) argued that teachers often transfer what they understand of the curriculum to their students and Cuban (1992) also believes that students do return home with different understandings of what was taught. This suggests that, different understandings by learners make the attained curriculum different. As a result, each teacher teaching physical Science CAPS needs to teach learners and also assess learners in order to ensure that learners still remember or have achieved the implemented curriculum as planned.

Furthermore, the above highlighted literature on intended, implemented and achieved curriculum suggest that those teaching physical science should clearly have an understanding of all dimensions of curriculum because this three dimensions (intended, enacted and achieved curriculum) are integrated. However, none of the above mentioned literature has looked at teachers reflecting in these three dimensions, especially teachers who teach Grade 12 physical science CAPS. Studies from the literature have used a case study as research design or style. Thus, this indicates that there is a need for a study to be conducted with the action research style where teachers are to reflect on the implemented, planned, and achieved curriculum.

Furthermore, Van den Akker et al. (2009) reveals that the intended curriculum (plan) and enacted/implemented curriculum (teaching) yield the achieved curriculum (results). According to Van den Akker et al. (2009) curriculum is divided into international curriculum (SUPRA), national curriculum (MACRO), school/institution curriculum (MESO), classroom/teacher curriculum (MICRO) and learner curriculum (NANO). In the case study conducted by Khoza (2015a) on student teachers' reflections on their practices of Curriculum and Assessment Policy Statement (CAPS), the South African curriculum has been defined in terms of the intended/planned curriculum as the formal or official document (MACRO) from the Department of Education and all schools have their own curriculum (MESO) and MICRO curriculum (teacher). Therefore, such studies from the literature generate a huge debate on competence versus performance curriculum.

2. 4 Competence/integrated curriculum versus Performance/collection curriculum

According to curriculum theorist Bernstein (1975) there are two suggested model/approaches to curriculum: competence approach and performance approach. This suggests that this kind of models help one to compare various type of curriculum in relation to the same characteristics. According to Hoadley and Jansen (2013), differences between competence curriculum and performance curriculum is defined by looking at learner control over curriculum, teacher role towards implementation of the curriculum, teaching methodology (focus), knowledge (every day or school), assessment (presence or absence) and learning space.

2.4. 1 Competence/integrated curriculum

The study conducted by Khoza (2015a) reveals that during the Apartheid era, curriculum in the South African context was driven by Christian National Education (CNE) which encouraged rote learning. The study outlines that after CNE, Curriculum 2005 (C2005) was introduced in 1998 which was driven by outcomes-based education (OBE). In 2005 South Africa introduced another new curriculum called the National Curriculum Statement (NCS) to replace C2005 but outcomes based education (OBE) as the approach continued to be utilised. The OBE approach is in line with the idea of curriculum theorist Friere's (1985) approach to curriculum implementation which is in line with that of Bernstein's competence model of curriculum. Hoadley and Jansen (2013) believe that the competence curriculum puts more focus on the learner, teacher, methodology, knowledge, assessment and learning sites.

In addition to the above, Hoadley and Jansen (2013) believe that competence/integrated curriculum encourages built-in competences to emerge from learners. This suggests that the focus is for learners to build their confidence on the curriculum. That is evident when Hoadley and Jansen (2013) assert that learners have a measure control over the way they learn (selection), when they learn it (sequence) and how quickly they learn it (pace). As a result, in competence curriculum it is assumed that learners can use different speeds and methods in order to understand the concepts in a particular context. This suggests that, this may help teachers in their reflections of the teaching physical science curriculum in order to understand that learners are different and they learn at different pace or level.

Furthermore, the South African Schools Act 84 of 1996 defines a learner as any child who receives education at school level. In addition a study conducted by Moodley and Hobden (2010) highlight the importance of learners in the teaching of physical science by exploring Grade 10 Physical Science learners' conceptions on the Nature of Science (NOS). Open-structured questionnaires were used for data generation from learners in seven secondary schools. The study concluded that learners possess some contemporary curriculum aligned with conceptions about certain aspects of NOS. This suggests that for teachers to reflect easily of their teaching of physical science curriculum learners should be taken into consideration since learners tend to take control of their learning in the competence curriculum.

Furthermore, Hoadley and Jansen (2013) portray that in competence curriculum a teacher acts as facilitator and a teacher's role seems hidden. This suggests that during the teaching process a teacher puts more focus on an individual learner in a classroom. Schmidt (2012) stipulates that a teacher instructs specific skills and content to learners according to the curriculum. The report by Osborne and Dillon (2008) outlines that good science teachers are teachers that are knowledgeable about science and its nature; have some understanding of basic educational ideas; use a range of teaching approaches; have a unique communication skills; and hold a passion for science. Therefore, the results of this report conclude that teachers must facilitate the teaching process which may assist them to easily reflect on their teaching of the physical science curriculum. This may in turn enhance them to know their teaching methods or pedagogy. In addition, Hoadley and Jansen (2013) assert that in the competence curriculum, teacher methods are learner-centred since learners are taken in high consideration during teaching process. This suggests that, a teacher's teaching methods reveal the kind of knowledge that the learners must construct.

Hoadley and Jansen (2013) assert that the competence curriculum encourages everyday knowledge (knowledge that comes from people's opinions). In this view, knowledge is always located on the problems and projects, rather than subjects that are given to learners. This idea concurs with that of Freire (1985) who indicated that everyday knowledge can be constructed by learners from conversation, radios and television, watching parents, punishment, etc. This suggest that this model encourages teaching that relates to learners experience which helps learners in their lives and work. As a result learners become confident irrespective of their socio- economic background. Hoadley and Jansen (2013) further believe that everyday knowledge is oral, hence it is easy for learners to forget what is taught; everyday knowledge is based on opinions and it is personal, it is local and not international. This suggests that everyday knowledge is dependent on the learners' family, community, context and culture. In other words, competence curriculum encourages local knowledge as compared to international knowledge.

In addition to the above, Hoadley and Jansen (2013) articulate that learners are expected to arrive at an outcome but that it does not matter how or when the learner achieves that outcome. As a result, assessment is based on what learners know (presence). This suggests that assessment is about checking if learning outcomes have been achieved by learners and that learners do not fail because they are allowed to achieve different outcomes at different levels. In the competence curriculum, teaching subjects are referred to as areas where teaching and learning can take place (Hoadley & Jansen, 2013). A case study by Khoza (2015a) outlines that in South Africa, C2005, RNCS and NCS were the three examples of competence/integrated curriculum where learning outcomes were given more privilege than the content and an OBE approach was used. This suggests that assessment should be given priority by teachers. Further to this, the competence model encourages that teaching and learning should take place everywhere whether at work or at home and this assists learners to have control over the selection, sequence and pace. In competence curriculum there is integration between various offered learning outcomes. This suggests that if teachers have a clear understanding of the competence curriculum they can more easily reflect on their teaching practices of physical sciences curriculum.

The above discussion from the literature clearly suggests that teachers should reflect on issues around learner, teacher, methodology, knowledge, assessment and learning sites, if their teaching practice is to fit in the competence mode of curriculum. On the other hand, from the studies mentioned on this section 2.4.1, those teaching physical science have not been reflecting on competence curriculum. As a result, a need arises for a study to be conducted so that teachers will reflect specifically on their teaching practice of the physical science curriculum in order to close the gap.

2.4. 2 Performance/collection curriculum

DBE (2009) asserts that at the end of 2009 another curriculum called Curriculum and Assessment Policy Statement (CAPS) was presented by the Ministerial Review Committee. As a result, CAPS has been implemented in schools since 2012. Furthermore, CAPS is in line with Bernstein's (1975) performance model of curriculum and Tyler's (1959) product approach to curriculum where the focus is on high levels of understanding of subjects. Hoadley and Jansen (2013) affirm that for teachers to understand and reflect on the performance curriculum, they should note factors which include the learner, teacher, methodology, knowledge, assessment, and learning sites.

Furthermore, Hoadley and Jansen (2013) assert that in a performance curriculum the main focus is on the subject to be taught, including the content. In other words, the focus is on the teaching methodology or pedagogy of subjects. Subjects are demarcated, not linked, and there is no integration among the subjects. This suggests that, in performance curriculum there are no concrete rules which determine how to learn. The focus is always on what is to be taught (content) and teaching methods are teacher-centred. Further to this, each subject stands on its own and a collection of its terms and concepts are strictly established for that subject. Additionally, the DBE (2009) indicates that the implementation of any curriculum is dependent on the teachers who implement it and how teachers make sense of the curriculum. This suggests that the failure or success of the physical science curriculum depends on the teaching methods used by a teacher. But, through their reflections a lot can be learned in the present which can be used in the future course of their teaching practice.

Bernstein (1975) further reveals that the knowledge is linked to formal school knowledge (knowledge that comes from research). The performance curriculum does encourage school knowledge rather everyday knowledge because school knowledge is taught systematically with simpler tasks that build on each other to make more complex tasks. Moreover, Bernstein (1975) assert that school knowledge is not oral, but written, which assists learners over time. In performance curriculum school knowledge does not generalise since it depends on studies. This suggests that school knowledge is based on evidence (research) and that school knowledge depends on a national curriculum like CAPS (in South Africa). It would be easy for teachers to reflect on their teaching practices of Grade 12 Physical Science CAPS. In performance/collection curriculum school knowledge is structured into subjects (like mathematics, physical sciences and life sciences) where teaching and learning can occur within the demarcated learning sites.

In performance curriculum process of learning is controlled by a teacher, "the role of teachers tends to be overt" (Hoadley & Jansen, 2013. p. 91). Thus, teachers have much control over selection, sequence and pace during the teaching and learning process. This suggests that a teacher transmits knowledge according to pre-defined methods or rules and that teachers decide what is going to be taught, including what activities are to be done in reference to the intended curriculum. Bernstein (1975) asserts that performance approaches are thus more content and teacher-centred. This is in line with the case study conducted by McDermott and Shaffer (2011) on preparing teachers to teach physical science by inquiry. The findings indicate that teachers need the time and guidance to learn basic physics. This suggests that teachers should be given the opportunity to examine the nature of the subject matter or content in order for them to reflect on the selection, sequence and pace of their teaching.

Hoadley and Jansen (2013) believe that in performance curriculum learners has little control on the way they learn, when they learn and the pace they learn. It is therefore assumed that not all learners can learn at all levels. As a result, teaching takes place in specific learning sites or places such as classrooms, laboratories and training workshops organised for school knowledge. This suggests that adequate resources (learning sites) may have an effect on learners' performance in curriculum. Furthermore, the case study conducted by Mji and Makgato (2006) intends to establish learners' views and educators' views about factors that contribute to poor performance in mathematics and physical sciences. Participants were purposefully nominated from seven schools with poor pass rates in District 3 of Tshwane North. Results of the study indicate that some of the factors that have a direct influence on poor performance are related to teaching strategies, content knowledge, and poor infrastructure (learning sites). This indicates that learners and learning sites play a major role in teachers' reflection, especially for teachers that are teaching physical science curriculum.

Hoadley and Jansen (2013) further indicate that assessment in performance curriculum is also based on what a learner does not know (what a learner has left out). Assessment follows a vertical approach where learners have to start from simple content to complex content. There is specific assessment criteria stated in the intended curriculum such as levels 1-7. Levels are structured according to the percentage stated in CAPS document, if a learner doesn't meet them then the learner fails. Khoza (2015b) and Hoadley and Jansen (2013) go a step further by outlining that in order to assess learners to achieve attained learning outcomes, forms of assessment like formative and summative assessments play a key role because these forms of assessment are part of learning. This suggests that those teaching the physical science curriculum should involve themselves such kinds of assessment as it encourages scientific knowledge for international recognition.

As a result, the discussion from the above literature makes it clear that teacher's reflections on the issues of learner, teacher, methodology, knowledge, assessment and learning sites will determine if teaching practice is of performance or competence mode of curriculum. However, from the studies, those teaching physical science have not reflected on such issues. The studies mentioned used case studies as a research style. As a result, there is a need to conduct action research to close the gap so that teachers will be involved in the reflection of their teaching practice of physical science curriculum. This may assist teachers to see if their teaching is competence or performance based.

2. 5 Conceptual framework

Christiansen et al. (2010) assert that a conceptual framework is the set of ideas or concepts that conduct the research in order for each study to have a particular area of focus. With a conceptual framework the study will be surrounded by certain key ideas or concepts. The conceptual framework is a well-developed explanation of events in such a way that it can link two or three key concepts or principles in one study. Silverman (2013) believes that the conceptual framework provides an overall framework for viewing reality and that it informs the concepts we use to define our research problems. Thus, various concepts of the curriculum are utilised in the study to explore teachers' reflections on the teaching of the physical science curriculum. "Concepts enable us to impose some sort of meaning in the world; through them the reality is given" (Cohen et al., 2011, p. 9).

In addition to the above, the debates in the literature revolve around the concepts of curricular spider-web, which are: rationale/vision, accessibility, aims/objectives, teaching activities, resources, teacher role, location, time, content and assessment. See Khoza's (2013a) paper on eight Educational Technology lecturers who use web-based teaching and learning environments to teach their modules at a South African higher education institution. The study was framed around the curricular spider-web concepts developed by Van den Akker et al. (2009). This suggests that framing this study around concepts of curriculum spider-web will yield prolific literature. As a result, this study therefore adopts the curricular spider-web by Thijs and Van den Akker (2009) as its conceptual framework and includes the issue of quality in education. Figure 2.2 overleaf shows an adopted curricular spider-web that will be used in this research study.

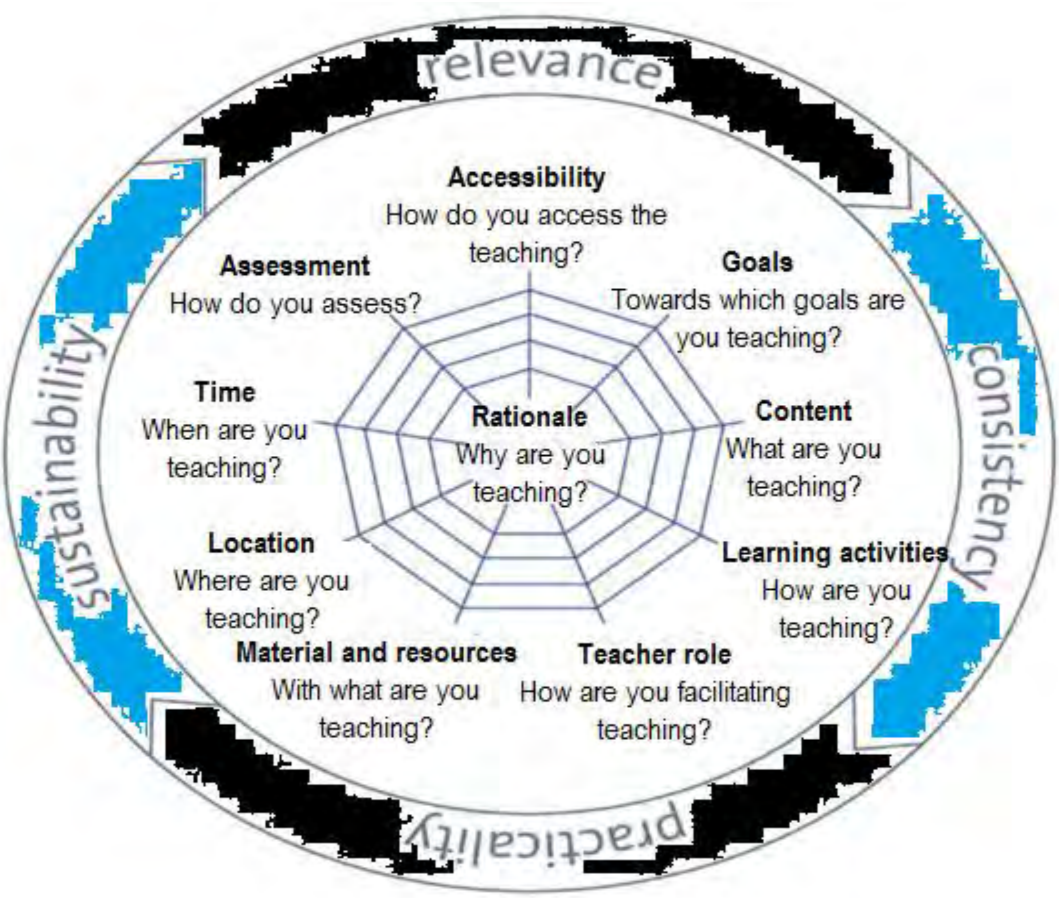

Figure 2.2: The curricula spider-web and education quality framework adopted from Berkvens et al, 2014, p, 8.

In addition, Van den Akker et al. (2009) simplified these concepts of vulnerable curricula spider-web by putting them in a question format in order to be more easily understood. The questions are as follows: How do you access teaching (accessibility)?; Why are you teaching (Rationale/vision)?; Towards which goals are you teaching (Aims/objectives)?; What are you teaching (Content)?; How are you teaching (Teaching activities)?; With what are you teaching (Resources)?; How do you facilitate teaching (Teacher role)?; Where are you teaching (Location)?; When are you teaching (Time)?; and how do you assess teaching (Assessment)? .

Furthermore, according to Van den Akker et al. (2009) the spider's web metaphor emphasises both the interconnectedness of all the concepts as well as the vulnerability of the structure that connects them. This suggest that, if one concepts is missing during the implementation of any curriculum, the spider web will collapse and make any dramatic shift that will pull the entire spider web out of balance. As a result, the spider web concepts are likely to be at risk of being vulnerable and be destroyed altogether. Thus, the balanced usage of all concepts will bring consistency and relevance in various components of the curriculum (Berkvens et al., 2014). This suggests that, the relevance of the components varies across the curriculum levels (intended, implemented and achieved curriculum). For instance, curriculum documents at the macro level (e.g. a national curriculum) usually focus on the rationale, aims, objectives as well as curriculum documents at the micro level (e.g.textbooks).

Van den Akker et al. (2009) assert that one of the major challenges for curriculum improvement is creating the balance and consistency between the various components of a curriculum spider-web. It is for this reason that Berkvens et al. (2014) includes the four quality criteria which revolve around the spider-web concepts and focus on relevance, consistency, practicality and sustainability. Together, they ensure balance between the various components of the curriculum. This suggests that each quality criterion could be applied to each strand of the curricular spider-web issue. Effectiveness of a curriculum will also depend on "its relevance, consistency, practicality and sustainability" of all spider web concepts (Berkvens et al., 2014, p. 8). See the Figure 2.2. However, the concepts of goals from curriculum spider web are indicated as aims and objectives which are on the side of the teacher (Van den Akker et al., 2009). Further to this, goals are missing learning outcomes. Learning outcomes are on the side of learners. According to Harden (2002), aims and objectives are useful when education is driven by the teacher-centred approach (performance curriculum) but when curriculum is driven by the learner-centred approach (competence curriculum) objectives are no longer relevant but learning outcomes are. As a result, CAPS has aims and objectives and there are no learning outcomes. This suggest that curriculum spider web concepts are relevant to Physical science CAPS.

Van den Akker et al. (2009) asserts that of all components have to be coherently addressed for successful implementation and continuation. This suggests that if all the concepts of the curricular spider-web are given equal attention, the intended curriculum would be smoothly implemented. During the implementation process, the concepts of the spider-web is not always pulled equally and some will be pulled more strongly than others (Khoza 2015a). This suggests that both the reviewed literature and the findings of this study will show how physical sciences are implemented within the concepts of the curricular spider-web. Some concepts are intertwined to form one strand. It is for this reason that this study will use the curricular spider-web as conceptual frameworks/theories/approaches to frame this study. Thus, the curricular spider-web attempts to unpack issues around teacher's reflection on physical sciences CAPS from a different angle of action research in the critical paradigm where teachers will plan, implement, assess or reflect so that they can learn and transform In order to improve their teaching practice.

2. 6 Curricular Spider-web concepts

According to Hoadley and Jansen (2013) curriculum is taken from a Latin word called currere with means to run a course. Both Hoadley and Jansen (2013) agree with findings from the case study conducted by Khoza (2014b) because the main purpose of the study is to explore the lecture's reflective experiences on becoming a published scholar. The study uses semi structured interview and lecturer's reflections for data generation. The study concludes that running a course involves "rationale for the course" (Khoza, 2014b, p. 96). This reveals that rationale acts as the core of issues like aims/objectives, teaching activities, resources, assessment, location, time, accessibility, teachers' role and content. The study revealed that these concepts play a major role in all curriculum stages, which are intended, implemented and assessed curriculum. However, these concepts, according to Khoza (2015a), are regarded as learning signals or e-learning signals where it is indicated that the rationale forms the central part of the curricular spider-web for all teaching components. Thus these themes are explored in the literature below.

2. 6.1 Rationale of teaching Grade 12 Physical science CAPS

Van den Akker et al. (2009) describe the rationale as a response to the question of why a subject is taught in school. In other words this suggests that teachers teaching Grade 12 Physical Science CAPS should have a rationale for teaching. There are various studies that state the rationale as to why teachers are teaching. The study conducted by Berkevens et al. (2014) reveals that teachers' reflections on the rationale of teaching should be based on three propositions: the personal rationale (pedagogical), societal/social rationale, and content rationale.

In addition to the above, see a case study by Kehdinga (2014a) on six university students of Kwa-Zulu Natal. The purpose of the study is to explore the concepts of thousand theories on the implementation of the curriculum. Semi-structured interview was used to generate data and purposive sampling was used in selecting samples. The study discovered that the issue of personal rationale plays a major role to teachers in order for learners to attain the achieved curriculum. The personal rationale helps teachers to easily master the implementation of any curriculum. Hence, teachers are producing thousand theories during their teaching practice. This suggests that teachers have a thousand personal rationale of the teaching of physical science curriculum. Kehdinga's (2014a) findings concurs with that of a case study conducted by Khoza (2015a) on student teachers' reflections on their practices of CAPS when recommending that teachers should identify theories that underpin CAPS before the curriculum implementation in order for them to understand the implementation process and the rationale as to why are they teaching. The students' project analysis, one-on-one semi-structured interview and focus group discussion were used for data generation in the study. Khoza (2015a) further articulates that there are many rationales why teachers teach Grade 12 CAPS subjects, "participant 13's account suggests that she had a passion for her subject as she believes that South Africa is running short of doctors" (Khoza, 2015a, p. 9). This suggests each and every teacher teaching physical science curriculum can display various reflections on the rationale of teaching. In fact, this suggests that personal rationale, such as a passion for teaching, comes before any other rationale in the teaching of curriculum.

Furthermore, an interpretive case study of two groups of students and a facilitator conducted by Khoza (2014a) establishes some of the reasons why facilitators facilitated the module. In the study, document analysis, semi-structured interviews and participant observations were used for data generation and purposive sampling was used in selecting participants. The study findings are similar to that of Khoza (2015b) and Kehdinga (2014a) which revealed that one of the reasons why facilitators conducted research modules was because they wanted to transform students from what they do not understand to what they will know after doing a research. The study also reveals that the rationale for facilitating the research module can be viewed from the side of the facilitator or the student. This suggests that, the rationale for teaching of the physical science curriculum can be viewed from the personal perspectives of both teachers and learners. The findings from the studies suggest that personal experience can play a major role for teachers to reflect on the rationale for teaching physical science curriculum. Further to this, curriculum relates to the "personal dimension of schooling"

(Kehdinga, 2014a, p. 127). Studies on personal rationale of teaching physical science indicate that personal reasons are powerful and are the most influential rationale that drives teachers to teach physical science (Khoza, 2015a; Kehdinga, 2014b; Khoza, 2014a; Schmidt, 2012). These studies further highlight that one has to be aware of personal issues as they may over power the societal and content reasons.

In addition to the above, teachers teach because of the societal rationale from their own community, some teachers teach because of the needs from the community. Furthermore, both Schon (1995), Kehdinga (2014a) and others share the same idea based on societal rationale. Further to this, Khoza (2015b) takes a step further by asserting that the society should enlarge the professional behaviour that will promote professional effectiveness in the implementation of curriculum. Teachers as professionals should understand the rationale behind teaching values to learners living in the community. This suggests that teachers may teach because they want to contribute to the teaching of learners from the society. In other words, some teach the physical science curriculum to learners from the community irrespective of gender and socio-economic background, and because they want to assist learners in order to give back to the community.

Furthermore, Schmidt (2012) stipulates that a teacher needs to be qualified (content rationale) in order to instruct specific skills and content to learners according to the curriculum aims and development level. This suggests that, those (curriculum implementers) who are teaching physical sciences content (implemented curriculum) should be trained and qualified to teach in order to instruct relevant skills to learners and attain curriculum stated aims. Further to this, it is clear that teachers teach because they are guided by intended curriculum to teach physical science content. This is evident when Khoza (2015a) asserts that some participants taught their subject content based on what the CAPS documents stated, "participant 21 suggests that she was following the instruction from CAPS documents" (Khoza, 2015a, p. 10). This suggests that some qualified teachers are teaching because they understand the content of the subject like physical science which support school knowledge. School knowledge is dependent on teachers' qualifications in order to implement the physical science curriculum and this will enhance teachers to reflect on their teaching practices.

Moreover, Carl (2012) and Berkvens et al. (2014) addresses the issue educational quality challenge on curriculum. These studies assert that curriculum teaching involves transformation of the intended curriculum into the implemented curriculum. This suggests that any personal, social and content rationale for teaching physical science curriculum may help to ensure quality assurance in all curriculum spider-web concepts. Further to this, even in the South African context, teachers' reflection on rationale of teaching may enhance the quality assurance in the teaching of CAPS. Thus, these rationales are based on a vision by the education Department through the CAPS document and this suggests that, a good and valid rationale of teaching can enhance correct implementation of Grade 12 CAPS. However, CAPS (2011) does not state rationale as to why teachers teach Grade 12 Physical Science hence teachers will have rationale as to why they are teaching. Khoza (2015b) outline that any curriculum have its reason for development. This suggests that, CAPS has its rationale and CAPS is a performance curriculum which supports school knowledge based on content rationale. This suggests, that CAPS must state rationale as to why teachers teach physical Science curriculum. As a result, qualified teachers may have a passion to teach physical science CAPS since CAPS supports school knowledge. As a result, the issue of quality assurance in a curriculum articulated by Berkvens et al. (2014) may be assured if qualified teachers are able to teach or implement physical science content at any local context. This suggests that, if teachers cannot teach physical science CAPS as intended in any local given context, CAPS may fail. Furthermore, since there is no stipulated rationale in the CAPS document as to why teachers are teaching, this suggests that it is not practical for teachers as professionals to work towards the vision of Education Department. Therefore, there are slim chances that CAPS may sustain. As a result, this may yield poor pass rate.

Furthermore, the above highlighted studies states various rationale, from different perspectives, of teaching. This suggests that those teaching the physical sciences curriculum should be aware of the rationale for teaching their subjects. However, none of the above-mentioned studies have used an action research style to explore the rationale why teachers teach but interpretive case studies were used. Thus, there is a need for a study to be conducted in the action research style where data is generated from not only semi-structured interview but also reflective activity and focus group discussion. Furthermore, findings from the literature in the above studies indicate that studies did not involve teachers to reflect on rationale for teaching. In fact, this invokes the question of access to schools by teachers and this suggests that that the rationale is also driven by accessibility.

2. 6.2 Who is teaching Grade 12 Physical science CAPS (Accessibility)

Teachers teach learners at school; a learner is described by the South African School Act No. 84 of 1996 as any person receiving education at school. Berkvens et al. (2014) concludes that education is a fundamental universal human right and no children shall be deprived of education. This suggests that, children should have access to education so that they can be taught physical science curriculum by teachers, regardless of their ethnicity, socio-economic status or gender. This further suggests that without involvement or access of teachers in implementation of a curriculum, there may not be any access to education by learners. As a result, without access to school by teachers in order to teach, curriculum implementation may fail. In addition, Berkvens et al. (2014), believe that accessibility in education by teachers depends on many aspects which includes the physical access (is it possible to reach school), the financial access (is the education affordable) and to the cultural access (is the programme socially acceptable).

Thus, Bernstein (1975) asserts that the performance approach to curriculum encourages demarcated learning sites (physical access) such as school classrooms but in the competence curriculum teaching can occur anywhere. In other words, this suggests that those teaching the physical science curriculum should have access to any physical infrastructure where teaching might proceed so that they may reflect of their teaching practice. The National Education Policy Investigation NEPI (1993) indicates that some schools are located in rural areas and some are located in urban areas. As a result, this has an input on accessibility of schools by those teaching the science curriculum since most teachers prefer to go to urban school than rural schools. This suggests that schools in rural areas are not easily accessible due to bad geographical conditions which include gravel roads and crossing rivers. This also suggests that some schools are not easily accessible by teachers since teachers in rural schools use old vans to reach school and this puts their lives in danger since those vans are often involved in accidents. Teachers' reflection can bring transformation when it comes to access to schools. Bernstein's (1975) inputs are in line with those of Chapter Two of NEPI (1993). NEPI (1993) reports that in South Africa race and gender influences the issue of accessibility in schools. Racial segregation during apartheid had impact on school functionality. This suggests that 'Model C' schools have more resources for implementing physical science than public schools. As a result, teachers are more attracted to well-resourced schools than poorly resourced school. Physical access to school is the key area that shall be considered in the implementation of the curriculum (NEPI, 1993).

Furthermore, the DBE (2012) in South Africa indicated that there is a shortage of teachers teaching scarce subject like mathematics and physical science in schools. As a result, the department proposed a Funda Lushaka Bursary scheme to financially assist (financial access) teachers to further their studies in mathematics and science at an initial state, but now it also caters all fields in education. In other words this suggests that, financial constraints in the DBE may deny teachers access to schools in order to teach Physical science curriculum. This also clearly suggests that teachers struggle to pay transport to schools. Some teachers are not qualified and for this reason they are underpaid which does not motivate them to teach the physical science curriculum. This may in turn affect the learners being taught the physical science curriculum. Furthermore, Prinsloo (2005) conducted a case study with the purpose of examining the current situation in South African schools with regard to school safety. The study indicated that after 1994, South Africa passed several pieces of legislation protecting the rights and safety of learners in South African schools. These Acts are all, to a large extent, concerned with protecting the physical and psychological integrity of learners in schools so that learners can have access to education. This suggests that those teaching the physical science curriculum should be financially protected so that, they have access to schools to ensure the safety of learners' right to education.

In addition to the above, CAPS (2011) is silent on who can access the teaching of physical science CAPS. This suggests that Grade 12 Physical Science CAPS can be taught by any teacher irrespective of culture, gender and a race (cultural access). The case study conducted by Dlodlo (2010) describes the impact of socio-economic factors on girls and women's access to Information and Communication Technology (ICT) education and training in a rural South African environment. The study recommends strategies for improved access to ICT education and training which includes good language of teaching for learners and professional development for teachers. This suggests that those teachers teaching the physical science curriculum should access ICT skills; it is their responsibility to encourage the language of teaching and learning (English), especially in rural schools. Teachers should also get enough development from content workshops and other skilled or lead educators. As a result, teachers will have much control over the subject and learners in order to avoid dropout of learners doing the physical science curriculum. Suggesting further on the grounds of cultural differences, teachers may be allowed teach physical science curriculum in any school irrespective of race, linguistic grounds and religion.

However, studies from the literature did not look specifically at the accessibility of Grade 12 Physical Science CAPS teachers and most studies were conducted with the case study style of research. In this respect, there is a need to conduct action research in order to bridge the gap in teachers reflecting on the teaching practice. Furthermore, accessibility is determined by goals (aims, objectives and learning outcomes).

2. 6.3 Goals towards which teachers are teaching (aims, objectives and learning outcomes).

Goals are an important aspect of the planning of teaching and learning practice. Kennedy, Hyland and Ryan (2006), Donnelly and Fitzmaurice (2005) and Khoza (2015b) assert that goals towards which teachers teach should be determined by aims, objectives and learning outcomes. Both Kennedy et al (2006) and Khoza (2015b) portray good and understandable definitions of these goals: aims are defined as a broad general statement of teaching intentions written from the teachers' point of view based on the content; objectives are referred to as "specific statement of teaching intention" (Kennedy et al, 2006, p. 5). This suggests that learning outcomes are what learners need to know, demonstrate, understand, or be able to do at the end of each lesson.

Furthermore, both Kennedy et al. (2006) and Khoza (2015b) place an emphasis on the importance of aims in the implementation of the curriculum, such that they even believe that aims give the broad teaching purpose of subjects like Physical Science. This suggests that, how the subject should be taught is dependent on the stated broad aims of each subject from the intended curriculum. The importance of the aims of subjects like physical science is evident when Khoza (2013b) continues to emphasise the issues of aims in his interpretive case study of six facilitators who teach publishing research at one of the universities in South Africa. Document analysis and semi-structured interviews were used for data collection purposes. The study concludes that in the South African context in National Curriculum Statement-NCS (intended curriculum), outcomes were divided into critical outcomes and learning outcomes. Critical outcomes were twelve generic statements that were generated by the “South African Qualification Authority (SAQA)” per subject, as offered from the intended curriculum (NCS) (Khoza, 2013b, p. 1). The study revealed that critical outcomes are linked to aims as they are broad statements for the teaching intention of each subject. This suggests that aims play a vital role in the teaching of a subject like physical science. Thus, it is necessary for teachers to be able to reflect on the broad statement of teaching (aims) during their teaching practice and it may also transform teachers in such a way that they properly implement the curriculum.

Furthermore, studies reveal that each and every curriculum should state the aims that curriculum implementers should intend to achieve. This suggests that teachers must be enhanced to have their own aims before the teaching of a specific content begins. Berkvens et al. (2014) asserts that the aims from the intended curriculum should include opportunities which could be made for learners to continue studying, have jobs and to create self-esteem that will influence the success of a learner. In other words, this suggests that aims of any intended curriculum should enhance the future of learners, which includes that learners have access to tertiary institutions.

In addition to the above, objectives show what the teacher wants to cover during the teaching process, and this is evident in the case study written by Khoza (2013a) on eight Educational Technology lecturers who use web-based teaching and learning environments to teach their modules at a higher education institution in South Africa. Data generation was done through document analysis, observation and one-to-one semi-structured interviews. The study revealed that through module objectives, students were able to use resources such as: those that you can see and touch (Hard-ware and Soft-ware) and those that cannot be seen and touched (Ideological-ware). This suggests that, the appropriate use of objectives by teachers during the teaching and the implementation of each subject like physical science may make it easy for students to grasp the content and concepts. Khoza (2013a) and Kennedy et al (2006) move a step further by explaining that objectives are specific statements that are generated according to the facilitators’ intentions and that objectives are broad statements of what a teacher can do for learners during teaching and learning. This suggests that teachers should use keywords like 'introduce', 'understand', 'know' and many others that are neither observable nor measurable in order to achieve what a teacher hopes to achieve by the end of each lesson. Khoza (2015a) outlines that on the one hand, both aims and objectives are generated according to the facilitators' intentions, while on the other hand, learning outcomes are on learners' intentions.

Furthermore, Donnelly and Fitzmaurice (2005), Khoza (2014a) and Berkvens et al. (2014) raise the issue of learning outcomes in their studies. Their studies conclude that learning outcomes are based on learners' intentions in order to fit learners' perspectives as per the intended curriculum. The studies further state that learning outcomes are generated according to Bloom's (1971) taxonomies of learning, namely: knowledge, comprehension, applying, analysing, synthesising and evaluating. The studies further articulate that the correct usage of Bloom's (1971) key verbs listed according to taxonomies leads to the correct formulation of learning outcomes. This suggests that learning outcomes are measured or observed from a students' performance and as a results teachers should use specific and observable keywords such as Bloom's taxonomies use of define, explain, critique, and evaluate. In other words, understanding the formulation of learning outcomes might assist teachers to reflect on learning outcomes in their teaching practices. This is supported by the interpretive qualitative case study conducted by Khoza (2014a) on five engineering students who were studying chemistry at a university in South Africa. The study concluded that a teacher-centred approach is utilised by lecturers while the students were trying to work as active students in engaging both Technologies in Education (hard-ware and soft-ware) and Technology of Education (ideological-ware). The study also found that the teacher-centred approach was not properly used because students were not given any intended learning outcome but were only given the aims and objectives as based on their modules.

However, Khoza (2014a) raised the argument that the spiders-web does not include learning outcomes as the proposition in this concept (goals). However, learning outcomes are more important than aims and objectives in terms of measuring students' performance for the positive attained curriculum. This suggests that the spider-web does not cover all concepts in evaluating the curriculum since learning outcomes are not addressed. On the other hand, learning outcomes play a very vital role in curriculum teaching. This further suggests that those teaching physical science should be able to reflect on learning outcomes and take it as a key goal even though it is not included in the curriculum spider-web.

In addition to the above, Van den Akker et al. (2010) reveal the three important elements of learning outcomes when one is dealing with a teaching or learning situation. The three elements consider whether outcomes were intended (but not implemented), implemented (but not attained successfully) or attained. In addition to that, Khoza (2013b) concludes that the intended outcomes are initial outcomes that are planned in order to drive modules and that they are planned before learning processes take place. The implemented outcomes are outcomes that are implemented to drive modules which are catered for during the learning processes. The attained outcomes are outcomes that are achieved by students at the end of a module and should be observed or measured after the learning process. This suggests that those teaching the physical science curriculum cannot teach science without any stated learning outcomes. Therefore, it calls for teachers to reflect on learning outcomes in order to understand them so as to transform their teaching practice. As a result, Khoza (2013b) asserts that learning takes place when modules are driven by learning outcomes because they are observable and measurable in terms of what students are expected to know and what they are able to do at the end of a lesson.

According to the discussions from the literature review highlighted above, aims, objectives and learning outcomes play a major role in any curriculum implementation. All in all, learning outcomes must be measurable and they take a preference from aims and objectives. However, the above studies did not look specifically at the aims, objectives and learning outcomes of Grade 12 Physical Science CAPS in the South African context. Most studies were done under interpretive paradigm to explore teachers' reflection on aims/objective and learning outcomes. It is therefore necessary to conduct a study that uses the critical paradigm for teachers to reflect on aims, objectives and learning outcomes. Furthermore, instead of using document analysis and one-to-one semi-structured interviews for data generation, there is a need to conduct a study that uses focus group discussion and reflective activity for data generation in order to bridge the gap.

Furthermore, CAPS (2011) stipulates the general aims of the curriculum in South Africa. These aims have been stated for all subjects from Grade R to Grade 12. According to CAPS (2011, p. 4), "this curriculum aims to ensure that children acquire and apply knowledge and skills in ways that are meaningful to their own lives. In this regard, the curriculum promotes knowledge in local contexts, while being sensitive to global imperatives". In addition, CAPS (2011) is aimed at producing learners that can identify and solve problems, work as individuals and in a team and also use science and technology effectively. In fact, this suggest that the CAPS document does include the specific aims of the physical science subject which includes some of the following: to equip learners with investigating skills relating to physical and chemical phenomenon; to promote knowledge and skills for problem solving; and also to prepare learners for future learning and employment.

However, the aims/objectives stipulated in the physical science documents are the general aims of the planned curriculum and the implemented curriculum. These aims/objectives are not specific to the teachers' intention when teaching a certain topic or content. For instance, there are no specific aims stated by the CAPS document for any teacher that is going to teach physical science concepts like electricity or organic chemistry. Further to this, there are no stated learning outcomes for Grade 12 Physical Science CAPS which means that teachers would find it too difficult to reflect on learning outcomes. Furthermore, Berkvens et al. (2014) suggest that what learners should learn depends on the aims and objectives which can outline the society (society values), subject (curriculum reflection) and student (creating opportunities). Thus, in the South African physical science curriculum, both general aims and specific aims are relevant since they do address the issue of society, subject and student. Practically aims/objectives cannot be implemented since aims/objectives are not specific to content stated from CAPS document. As a result, the South African curriculum may not sustain in future because there are no stated learning outcomes such as intended, implemented and attained learning outcomes. Thus, teaching and learning without observable learning outcomes may not be successful. This implies that there is no consistency since the physical science CAPS document does not align objectives to learning outcomes and this may lead to confusion among curriculum implementers. However, aims/objectives and learning outcomes are constructed based on the content or the subject matter (Van den Akker et al, 2009).

2. 6.4 Physical Sciences CAPS content

According to studies by Berkvens et al. (2014); Kelly (2009); Hoadley and Jansen (2013) and Carl (2012), decisions on content subject are determined by subject topics to be covered, practical work/experiments and subject knowledge. These studies move further by outlining that curriculum implementation must begin with considering what knowledge needs to be learned (subject knowledge) and what subject topics needs to be covered as per the intended curriculum. Both subject topics and subject knowledge are important elements of the curriculum implementation process. Therefore, subject content should be balanced, well sequenced and organised (Berkvens et al., 2014). These studies reveal that teachers should possess subject knowledge of their subjects and they should know the topics to be covered as per the intended curriculum. In other words, this suggests that teachers should take subject topics as an important aspect in the teaching of physical science curriculum. Studies also outline that physical science teachers should know what to teach and the required knowledge to be taught. Thus, this indicates that content can be defined by the approach that the intended curriculum adopts such as the competence curriculum approach which supports everyday knowledge and performance curriculum approaches which encourages school knowledge (Hoadley & Jansen, 2013).

The issue of content topics is detailed in a qualitative case study conducted by Shulman (1987) and by Hoadley and Jansen (2013) when asserting that a teacher is a scholar in that he or she must know all parts or topics of the subject. Teaching starts with teachers understanding of what is to be learned (subject topics) and how it has to be taught. Teaching ends with new identifications by both the teacher and student. Furthermore, studies indicate that a competent teacher knows the subject topics to be implemented. He or she also knows that the intended curriculum is often not contained in one document, and instead comes in a number of documents that outline the subject content (topics). These documents apply to different levels of the curriculum. In other words, studies indicate that those teachers teaching the physical sciences have a responsibility to master the subject topics that are prescribed in the intended curriculum. A teacher serves as a primary source of subject content during the teaching of the physical science curriculum. As a result, teachers cannot be judged by observing their performance without referencing the content they teach. In addition, it is clear from the studies that a teacher teaching the physical sciences curriculum should be familiar with all documents of the curriculum. For instance, in the South African context, teachers should be aware of documents like the CAPS documents, annual teaching and lesson plans. All these curriculum documents at the different levels of curriculum influence teachers to easily reflect of their teaching practice.

In addition to the above, a mixed method (quantitative and qualitative) study conducted by Lederman (1992) on students' and teachers' conceptions of the nature of science, concludes that science curricular vary broadly among countries, states, school districts, and individual schools. The differences are concerned with the particular science topics or concepts to be included. Lederman's (1992) conclusion is in line with findings from the study by Williams, Stanisstreet, Spall, Boyes and Dickson (2003) that when looking at physical science topics, some students are more interested in physics than chemistry. The study finds that most learners find topics in physics very interesting which includes electricity, energy, forces, and circuits, spectrum, magnetism and the solar system. The study reveals that the rationale why learners are interested in physical science subject is that, secondary school physical science is often taught by teachers whose primary qualification may be in science because those teachers have relevant content knowledge. This suggests that a teacher plays a measurable role in creating and conveying the interest of the physical science topics to learners, especially if a teacher is qualified to teach that science subject.

Moreover, a qualitative case study conducted by Kola (2013) on the effectiveness of teaching and learning in science education through application of ICT reviewed various applications of ICT in effective teaching and learning of biology education, chemistry education and physics education in secondary schools. The study revealed the deference between physics education and chemistry education. Chemistry deals with chemicals and their reactions most of which are very dangerous to life if not handled with caution. However, physics is regarded as a subject with topics that deals with study of any physical phenomenon. Physics is regarded as an abstract subject because of the way the teacher teaches it. This suggests that science topics in schools should address both physics content and chemistry content. Thus it is in the hands of each teacher not to make it abstract but to teach content as intended. Teachers should also be able to reflect on the teaching of physics topics and chemistry topic. Further to this, it is clear that a teacher may have more influence for learners to be interested in ether physics or chemistry part of science curriculum.

Furthermore, teachers should possess subject knowledge in order to teach physical science CAPS at micro-level as both "the content and the curriculum knowledge" are vital (Shulman, 1987, p. 7). Shulman (1987) believes that content knowledge entails knowledge of the subject and its structures or parts thereof, whereas curricular knowledge is characterised by certain programmes for the teaching subject. This suggests that each and every teacher teaching the physical science subject may possess content knowledge.

In the South African context, the Physical Sciences CAPS (2011) document states all the systematic topics, contents, concepts and skills to be taught by teacher, including all the prescribed practical activities or experiments. This suggests that teachers must possess enough content knowledge in order to implement the CAPS content. Adediwura and Tadyo (2007) and Khoza (2015b) assert that pedagogical content knowledge depends on an understanding of a specific subject knowledge for subject topic. It also depends on how to explain subject content in a way that will be logical to the pupils. Studies assert that teachers, as professionals, are able to interpret the content of each topic using their subject knowledge. This suggests that teacher's strength lies on subject knowledge and this makes it easy to teach the physical science curriculum. Further to this, studies also reveal that practical work/experiments put more focus on skill development and problem solving skills. Practical work/experiments must be designed in such a way that it invokes learners to use skills like planning, information gathering, synthesising, hypothesis and drawing conclusions. This suggests that teaching in physical science curriculum goes hand in hand with practical work/experiments.

The above-mentioned studies indicate some of the topics of the content to be covered in the physical curriculum science curriculum. These studies make it clear that the teaching of science content relies on the way the teacher teaches the content and on the way the teacher creates interest of content among the learners. As Hoadley and Jansen (2013) outline, through Tyler's (1959) approach to content, the Department decides which subjects to teach and what subject topics and knowledge to teach. In other words, this suggests that teachers must be provided with a syllabus that describes the content to be taught. In fact, studies articulate that curriculum content should be systematic, logical and mechanical and this will help teachers to know what to teach as prescribed.

However, most studies in curriculum content including the one mentioned above, data were generated using questionnaire and document analysis. There are few studies done where data was generated using the reflective activity and a focus group discussion. Thus, a need arises for a study to be conducted that may influence teachers to reflect on the subject content and where a reflective activity and focus group discussion may be used for data generation purposes. There is no qualitative study that is conducted specifically for Grade 12 Physical Science CAPS content. Therefore there is a need to conduct a study in order for teachers to reflect of their teaching practice. For the fact that, "having the same curriculum on paper does not mean that all schools experience the same curriculum-in-use" (Booyse & Du Plessis, 2008, p. 3). Thus it is necessary to conduct the studies that may put more focus at teachers' reflections.

Therefore, this raises the question of quality assurance in our South African curriculum (CAPS) as it is asserted by Berkvens et al. (2014) that any curriculum should address aspects such as relevance, consistency, practicality and sustainability in order to address the quality of the curriculum. Berkvens et al. (2014) further assert that any content in a curriculum should prepare learners for local life, future education and the world of work. Thus, this suggests that the physical science CAPS content is relevant to learners since it prepares them for tertiary studies. However, it does not train learners for the field of work since more time is given to theory than practical activities or experiments. On the other hand, there is no consistency in our CAPS since some of the specific aims in physical science are not achievable due to the local context barriers. Practically, not all physical science content is implemented. For instance, CAPS does prescribe material to be used in experiments, without checking the local context of each school whether there are required resources to execute that particular practical activity. This suggests that physical science CAPS will not be sustainable in future and that the content can also be affected by teaching activities in each and every school.

2. 6.5 Grade 12 Physical Science CAPS teaching activities

Chou (2011) refers to learning activities as the experiences that learners need in order to have particular behavioral competencies. CAPS (2011) suggests teaching activities/task based on formative assessment (informal), summative assessment (formal) and continuous assessment. As a result, there are three types of teaching activities (informal assessment activities, formal assessment activities and continuous assessment activities) that a teacher may engage learners on. This suggests that informal assessment activities should be taken as activities for learning because it includes all activities done by both educator and learner during teaching and learning process in order to inform the teacher on how learners are progressing. On the other hand, formal assessment activities are known as activities of learning done at the end of each teaching programme in order to see if learners have achieved the learning outcomes. Continuous assessment is done per term. In fact, some teachers fail to differentiate between these two kinds of activities (Chou, 2011), therefore I believe that teachers reflections might assist to bring clear understanding as when, how and why to use these activities.

Furthermore, Curriculum News (2010) concurs with what CAPS (2011) stipulates, when asserting that the informal activities such as observations, discussions, demonstrations, class work and home works should be used by teachers in the classroom as a stepping stone to prepare learners for formal assessment. In other words, this suggests that informal activities are used by teachers during the teaching and learning process in order to see if learners did understand what is taught. As a result, it becomes easy for teachers to provide feedback to prepare a learner for a formal task. This is in line with Curriculum News (2010) which articulates that informal tasks need not to be recorded since it is not meant for progression or grading purposes. CAPS (2011) reveal that, those informal tasks are done to give feedback to learners and inform planning for teachers but do not need to be recoded. This suggests that teachers should not stop doing informal tasks. Informal task must be made available when needed by School Management Team (SMT), Head of Department (HOD), parents and other education officials (Hoadley & Jansen, 2013).

In addition to the above, see a case study conducted by Taole (2013). The study employs a qualitative design using interviews for data generation. The purpose of this study is to explore and describe teachers' conceptions or reflections of curriculum review within the context of educational change in South Africa. The study reveals that teachers are critical change agents in the curriculum review process as they are the curriculum implementers who clearly understand which activities are to be done per each subject. Taole (2013) suggests that teaching activities will determine the success or failure of any curriculum. The study also showed that curriculum review remains a foreign concept for most teachers and that it presents challenges to their existing conceptions, including the types of activities that are intended to be implemented by teachers. This suggests that teacher support, like workshops, are still required to assist teachers in order to master some teaching activities. Some teachers still find it difficult to implement some of the prescribed activities due to the lack of content knowledge. This may lead to the failure of the curriculum. In other words, teachers teaching physical science hold certain understandings about the curriculum and its implementation. It is therefore important to bear in mind that teachers' implementation of teaching activities may lead to the success or failure of the curriculum implementation; therefore, teachers need to reflect of their teaching practice so that they will get support from the Department of Education in order to improve their teaching practice.

Moreover, formal activities are a more vital activity than any other teaching activity. This is because formal task are recorded for promotion and progression purposes. The recorded pieces of work must always be made available (Hoadley & Jansen, 2013). The Curriculum News and CAPS (2011) further stipulates that learners be given formal activities that should be marked and recorded for certification and reporting purposes. This suggests that all formal activities must be moderated by SMT for quality assurance. Both pre-moderation and post-moderation should be done in all formal tasks like tests, examinations, practical tasks, projects, etc. As a result, physical science teachers should design their own programme of formal activities to be done per each term. Further to this, formal activities are marked and recorded in order to allow parents to see the progress of each learner.

In addition to the above, Khoza (2015b); Carl (2012); and Van den Akker et al. (2009) concur with Khoza (2013a) when revealing that ideological-ware resources are the key resource for implementing formal teaching activities. The study points out that, "the learning activity principle is about the how of teaching/learning" (Khoza, 2013a, p. 55). In addition, the study concludes that lectures should use authentic activities which link students to real-world relevance so that students will actively participate in those activities. In other words, this suggests that physical science teachers must link their formal task to real-world relevance so that learners will see the need to do those given formal activities. Furthermore, teachers should give formal activities to learners that provide the opportunity to further their studies after completing high school level studies. Thus, during implementation of curriculum teachers should give formal activities that will address learners' needs for the future. Studies on formal task also state that it is important for teachers to choose the best activities for achieving the subject aims/objectives. This suggests that teaching activities be based on achieving teacher's intentions rather than learner's intentions and that teachers at the micro level of curriculum implementation have a right to choose which activities to take learners through in order to achieve the subject aims. Jansen and Hoadley (2013) suggest that the adopted curriculum approach will determine if the activities are learner-centred or teacher-centred. This suggests that teaching activities may also determine whether teaching activities do encourage international or local knowledge.

Furthermore, continuous assessment enhances continuous activities which are often determined by repeated summative assessments and formative assessment activities (Kennedy et al., 2006). This suggests that continuous assessment is about the combination of project and control tests given to learners. According to CAPS (2011), this kind of assessment should be conducted per each term. This suggests that teachers are compelled to give continuous assessment activity (CASS) to learners. As a result, CASS makes up a certain percentage in the final mark of a learner.

The literature above is of the view that teaching activities should address informal, formal and continuous activity. Activities should address the learning outcomes instead of aims in order for learners to actively participate in the teaching process. This suggests that teachers also play a major role in helping learners to execute their activities as intended by the curriculum. However, most studies are conducted within the interpretive paradigm. Thus, I feel the need to conduct a study using the critical paradigm so as to involve teachers in the research in order to understand physical science curriculum and teaching activities easily. But, for teachers to successfully implement activities they need to understand their role as well.

2. 6.6 Teachers role in facilitating Grade 12 Physical Science CAPS

According to the idea by Khoza (2013a, 2015a), which is in line with that of Hoadley and Jansen (2013), the teacher's role in the curriculum is driven by a teacher-centred (instructor), learner-centred (facilitator) and content-centred (accessor) approach which ensures a successfully achieved curriculum because of a good association between the intended and implemented curricular. These studies further articulate that it is vital for teachers to choose the relevant approach or approaches in order to spot their role in facilitation. This suggests that teachers should be aware of these approaches in their teaching in order for them to reflect of these approaches for transformation purposes. Getting further, studies articulate that when teachers use aims or objectives to drive their lessons, they are employing a teacher-centred approach; if teachers utilise content to drive their lessons it means they are using a content-centred approach; and if teachers utilise learning outcomes to drive their lessons it means they are using the learner-centred approach. Studies further outline that a combination of Tyler's (1959) product approach of teacher-centred role and Freire's (1985) political approach of learner-centred role may yield better results in the implementation of the curriculum.

Furthermore, a teachers' role is determined by the approach that the teachers adopt (Hoadley & Jansen, 2013). This suggests that, if a teacher adopts competence curriculum model. It means the teaching approach is driven by learning outcomes. Thus, learners are expected to arrive to an outcome but it does not matter how, when is the learner going to achieve a learning outcome. Thus, a teachers' role is learner-centred, suggesting that the teacher will act as a facilitator to guide learners' knowledge in order to constructs their own ideas during the teaching process. This concurs with the findings from a case study by Khoza (2015b) which outlines that most participants had to use the approach that comes first in order to finish their syllabus. This syllabus is presented to teachers by CAPS documents. This suggests that teachers are not aware of their role during teaching. As a result, it is vital for teachers to choose the relevant approach to position their teaching role within the teaching of the physical science curriculum.

In other words, this suggests that teachers should not only act as facilitators but that they should also act as instructors (teacher-centred). This makes implementation of any curriculum enjoyable by both parties (teachers and learners) involved since they share their own currere (Pinar, 2004). In addition, Hoadley and Jansen (2013) believe that when a teacher acts as an instructor, school knowledge is encouraged which emanates from research. This suggests that, teacher's role in physical science curriculum may influence teaching to take place in a specific platform like a classroom. This provides equal participation so that learners may easily grasp the content. When the teacher role is teacher-centred, assessment is based on what learners do not know (Hoadley & Jansen, 2013).

However, according to Sindhu (2012), teachers at school perform different professional roles or duties which include a teacher being a superintendent, a supervisor, a planner and controller or instructor. In other words, when a teacher acts as an instructor they exercise control over learners and other related activities of the school, which includes the selection of teaching activities, content and resources, sequence and the pace of teaching. This, according to Hoadley and Jansen (2013), reveals that it is "performance approaches which encourage more of a teacher-centred role driven by aims and objectives". In other words, teachers should encourage school knowledge (knowledge from research) which is systematically taken from the intended curriculum. Moreover, this suggests that teachers teaching the physical science curriculum have control over learners and all activities. Teachers decide what is going to be taught, including activities to be done according to the intended curriculum. This makes it easy for teachers to transmit knowledge according to the defined methods or rules.

Furthermore, Hoadley and Jansen (2013) reveal that Tyler (1959)'s approach to curriculum is teacher-centred and sequential. Tyler's (1959) style of teaching does not care whether learners have understood or not understood the concept during the teaching process. As long as the learner memorises, and is able to reproduce what the teacher said would be enough. In other words, Tyler's (1959) style to teaching suggests that a teacher should only teach the prescribed curriculum (objectives) and favours school knowledge over everyday knowledge. This suggests that Tyler's style of teaching is good for teachers because it is not time consuming, is straight to the point and does not need more resources during the teaching process.

In addition to the above, when teachers choose to adopt content to drive their lessons it suggests that the teachers' role is content-centred. Revit, Jason, Becker, Jay, Won and YanTien (2000) examine teachers' survey responses that describe the frequency with which their teaching practice involve teaching methods. The report revealed that teachers used Traditional Transmission Instruction (TTI) as the main approach to teaching. Transmission Instruction (TTI) is based at learning which submits that students will learn via the content (assessor), their teacher's explanations and by reading details from a textbook. In this approach, skills are learned via repetitive practice by a teacher in a sequential, systematic and highly prescribed manner. In other words, this suggests that those teaching the physical science curriculum should rely on prescribed content from the intended curriculum. This indicates that teachers should adopt Stenhouse's (1975) approach to curriculum which is not based on objectives but it puts more focus on the process of teaching the content as intended. Booyse and Du Plessis (2008) believe that Stenhouse's (1975) approach concentrate on content knowledge and guidelines for teaching. It is also written like recommendations and not like a prescription. This suggest that Stenhouse's (1975) approach wants teachers to research as they teach the content by involving learners in various activities during teaching. Teachers should appraise and change the course in the teaching process if necessary. This suggests that curriculum should be descriptive but not prescriptive so as to give the flexibility to teachers. That is the reason why Stenhouse's (1975) approach is viewed as process that cannot be predetermined because it changes with the context of the content and the learners involved. As a result of the above discussion from the literature, one can suggest that the intended curriculum must allow teachers to choose the approach based on the given learning environments. Further to this, resources may also influence the approach opted by teachers. As a result, the literature indicates that most studies uses case study as a research style for teachers to reflect on their roles, thus there is a need to conduct a study from an angle of actions research style so that participants will be part of the research. In other words, participants will also adopt relevant approaches to implement the curriculum in order to change from old traditional way of teaching to the improved approach.

Furthermore, based on the intended curriculum CAPS (2011) for physical sciences in South African context, the content is prescribed and there are prescribed and recommended formal, informal and continuous activities. For instance, in term 2 according to CAPS (2011) there is a prescribed formal task like an experiment on electric circuit with resistors in series and in parallel. On the other hand, CAPS (2011) does not specify teachers' role based on the teaching approach or methods (teacher-centred, learner-centred and content-centred) that teachers should use when doing such experiments. This suggests that teachers have to assume the teaching methods or approaches to use when teaching. It further suggest that physical science CAPS is not consistent for proper implementation by teachers. Therefore, there may be minor chances that CAPS may sustain for much longer. In fact, teachers' role alone will not prosper without resources for implementation of the physical science CAPS.

2. 6.7 Resources for teaching Physical Sciences CAPS

Teaching aids are sometimes called resources which are defined as anything that facilitates learning or "any person or thing that communicates learning" (Khoza 2012, p. 75). In addition, an interpretive case study conducted by Khoza (2013a) on university lecturers who use the online environment in teaching their modules, identifies three types of resources in education. The study identifies hard-ware resource, which are any tool or machine used in education; soft-ware resources, which are any material used with hardware to display data; and ideological-ware resource which are resources that we cannot see and touch in education such as teaching methods (teacher-centred, content-centred and learner-centred). The study outlines ideological-ware resource as the key resource that drives the teaching process in education. In other words, this suggests that if those teaching science can understand that learning is not only about hard-ware and soft-ware, but is also about ideological-ware (Amory, 2010). This suggest that, the teaching of the physical science curriculum would be simple because teachers would know what resources can be used for teaching in order to reflect on their teaching practices.

Furthermore, hard-ware and soft-ware resources play some role in the teaching process; see the case studies conducted by Nakpodia (2013) and Meier (1995) articulating on hard-ware and soft-ware. These case studies revealed that the performance of teachers depend on the capacity of the principals to conduct adequate supervision which certifies the importance of teaching resources. There are various hard-ware or soft-ware teaching facilities or aids that can be used: Audio-visual (textbook, television, etc.), Visual (mobile pictures) and auditory materials (listening activities). This suggests that school principals should provide hard-ware and soft-ware resources for teachers to use for the good implementation of the physical science curriculum. Thus, this seeks teachers to be able to reflect on the usage of these forms of resources in the teaching of physical science in the implementation of the curriculum. Studies conclude that teaching aids are of diverse kinds that teachers and students should use in a classroom. As a result, the teaching and learning process may be more real and prolific. Curriculum at micro level (teacher implementation) includes "lesson material and resources" (Van den Akker et al., 2009, p. 33). This suggests that teachers should make their own collection from the range of accessible educational materials and resources. Resources may support a day-to-day teaching process. Textbooks (hard-ware), internet and power point (soft-ware) can be viewed as the "carriers of the curriculum" (Van den Akker et al., 2009, p. 33). In other words, resources are very important when teaching a subject like physical science in schools and if the resources are not provided, the implementation might yield a high failure rate of learners.

In addition to the above, teachers who are curriculum implementers are also part of hard-ware and soft-ware resources. See the paper written by Kehdinga (2014b) which presents the findings of a qualitative case study of eight student teachers' experiences within the context of curriculum change in a university in KwaZulu-Natal. The qualitative data of the study was generated through two methods: semi structured interviews and document analyses. The study findings indicate that teachers are one of the most important resources during curriculum implementation in the era of curriculum change. The study outlines that teachers are change catalysts. Teachers play a major role in implementing the curriculum. Teachers are also taken as resources during curriculum implementation. This suggests that physical science CAPS teachers, whether qualified or not, act as resources in the teaching of the subject. This helps teachers to easily reflect on their teaching practice.

In addition, interpretive case studies conducted by Khoza (2015b) and Kehdinga (2014a) reveal various details on the ideological-ware resources. Studies reveal that some teachers are not aware of the ideological-ware (teaching methods) resource as being a key resource in education and that they are only aware of the hard-ware and soft-ware resources as stated in the CAPS documents. This suggests that hard-ware and soft-ware resources alone cannot totally assist in the implementation of curriculum without the use of ideological-ware resource. This indicates that even though a teacher may have hardware and software resources, but teaching without ideological-ware may be a fruitless exercise. Studies further emphasise that curriculum should accommodate the hundred thousand theories (ideological-ware) that teachers may want to use. This have to do with curriculum implementer's' personal, social and political dimensions of intended curriculum. This suggests that teachers must take ideological-ware into consideration for their reflections since it drives any curriculum in education. As a result, this shows that teaching of the physical science curriculum is not all about hard-ware or soft-ware but is also about ideological-ware. Therefore, curriculum implementers (teachers) should first understand the ideological-ware resources that underpin their intended curriculum before the implementation processes can begin.

As a result of the above discussion in resources from various studies, teacher's reflections may assist in examining if the intended curriculum does address the issue of resources like CAPS in South African context. Most of the studies above did not explore teacher's reflection on Grade 12 physical science curriculum resources and most used a qualitative case study which included data analysis, semi-structured interviews and observation for data generation. Thus, there is a need to address the issues of teacher's reflections from another angle of critical paradigm for emancipatory purposes. The use of action research may be appropriate because it involves teachers to plan, implement, evaluate or asses and reflect on the intervention adopted. Critical paradigm may bridge the gap in teachers' reflections.

In the South African context, physical science CAPS (2011) does specify the resources or material to be used by curriculum implementers (teachers) for the content but it only specifies resources for the prescribed experiments. For the presentation of the subject content or matter, there are no prescribed resources. Berkvens et al. (2014) outline the need of supportive resources for inspiring learning, suggesting that resources should have a practical use in a given settings. As a result, this suggests that if resources are not practically used, they will not be effective in supporting learning. Even if the resources are effective in promoting learning, they might be too expensive and this raises the issue of financial constraints in schools. Another issue is the size and quality of materials used. The study concludes that at times teaching aids might be cheap but these aids deteriorate fast in schools, especially when storage is problematic. In reality, sustainability of resources is of paramount importance. But Berkvens et al. (2014) indicate that digital resources might solve the problem of resource sustainability.

Moreover, there is often no guarantee that resources offered are used as intended. As a result, teachers need time to understand how to use the resources. Hence, resources might not be used as intended. The study further indicates that teachers need to be involved in their design and development of resources for implementation of the curriculum. This may lead to unused resources which can be found in all schools. In fact, CAPS (2011) outlines material to be used to implement the curriculum without ensuring the availability of those resources in schools. In most schools there are inadequate resources. This suggests that there is no consistency on the implementation. This is because different context (rural or urban) under which teachers are teaching. Thus, in CAPS implementation, resources may not be practically utilised. This may fail the teaching of the physical science curriculum. In some schools there is no electricity, thus teachers find it difficult to practically apply digital resources. However, time and location matter most in the usage of resources.

2. 6.8 Time and location of teaching Grade 12 Physical Science CAPS.

According to Van den Akker et al. (2009), time and location are different concepts as per curricular spider-web. In this study, time and location are is intertwined to one concept. See the qualitative case study by Khoza (2013b), which revealed that location is about where teachers are teaching. Time is about when teachers are teaching. Getting further, the study outlined that lecturers teach their students on campus using face to face contact classes by following the module time table. The lecturers also use after work hours to meet with part-time students. This suggests that teaching and learning might occur within a demarcated area. Teaching may also occur at allocated time. As a result, performance curriculum model is done only in a demarcated space like classroom and laboratories (Stenhouse, 1959). Khoza's (2013b) perception on time and location is in line with Bernstein (1975) when concluding that science activities should be held in a space designed to suit discussions, book reading and practical experience. These studies also concur with Coetzee (2009) when asserting that effective curriculum implementation may be facilitated by organising the physical space of the classroom. Classroom should be conducive by organising furniture and space in a manner that promotes appropriate teaching and learning. This clearly indicates that teachers' reflections should play a major role so that teachers are be able to manage time and create conducive teaching space in their schools.

Furthermore, see the paper written by Meier (2005) on both formal and informal education in educational institution which shares the same idea with Nakpodia (2013). These case studies find that learning is the essential activity of schools and universities. At times, learning does take place in classrooms (formal learning) while at other times it occurs in unexpected places (informal learning). This suggests that location or space can have a physical influence on learning and can encourage assessment and group work among learners. The studies concluded that all school principals should create a favourable environment and enough time for teaching and learning to occur smoothly via their supervision.

Furthermore, according to section 4 of the Employment of Educators Act (1998) all teachers should be at school for a minimum of 7 hours per day. Orstein and Huskins (1993) also point out that effective curriculum implementation needs more time for personal interactions and contacts among implementers and planners. In other words, this suggests that physical science teachers need to have more time with their CAPS documents and more contact time with learners. As a result, teaching of concepts will be easily understood and will not be quickly forgotten by learners. This is evident when Bennie and Newstead (1999) believe that for the programme to be implemented successfully more time is needed for planning and teaching. Physical Sciences CAPS (2011) also stipulate that physical sciences subject should be taught in four hours per week. The time allocated for a teacher to teach content, skills and practical work for Grade 12 Physical Science is "4 hours per week, with 40 weeks in total per grade" (CAPS, 2012, p. 9). For instance, Grade 12 physical sciences CAPS (2011) allocated only a total of 4 hours to teach electric circuit content which includes voltage, current, resistors in series, measurement of voltage and current, resistance, and resistors in parallel. This suggests that, this portion must be taught over a single week. I believe that this time is adequate for theory by not for the practical work. This shows that CAPS is a performance based curriculum since the focus is on the subject content and there is time allocated for each subject.

As a result of the above discussion from the literature, studies were conducted under interpretive paradigm using the case study as a research style. It is therefore necessary for other studies to be conducted using different paradigm to explore teacher's reflections. There are few studies conducted where teachers reflected on the teaching of CAPS subject. Thus, there is necessity for the study to be conducted using an action research under critical paradigm. The intention is not only to understand the phenomenon but also to transform teachers on curriculum issues like time management and approaches to be used during teaching.

In addition, the study by Berkvens et al. (2014) suggests that for quality assurance purposes in any curriculum, the learning space issues should be addressed. The study articulates that the learning environment should fit the modern and local context and that learning time should fit working hours and after work hours. Thus, in the South African context, Grade 12 Physical Science CAPS are not relevant to the local context because the CAPS document does specify experiments to be done. There are laboratories built in schools. Further to this CAPS is silent when it comes to contact time after school or during Saturdays (extra classes). As a result, there may be no consistency on the implementation of Grade 12 physical science CAPS. As a result, teachers cannot practically implement or teach the physical science curriculum since they cannot apply it in their own settings. Therefore, these are the signs indicating that CAPS may not sustain in the future.

2. 6.9 Assessing in Physical Sciences CAPS

Assessment, according to Hoadley and Jansen (2013), is critical because it deals with the measurements of teaching through different tools like tests, observation, and examinations. As a result, a qualitative case study by Liu and Carless (2006) suggest that the term assessment is often understood by marking and grading. According to Kennedy et al. (2006), assessment is often described in terms of formative assessment or summative assessment, including continuous assessment. Thus, teachers' reflection will assist teachers to understand this kind of assessment in their teaching practices.

Formative assessment is known as assessment for learning because it includes all activities done by both educators and learners during the teaching and learning process. This helps to inform teachers on how their learners are progressing. Furthermore, Khoza (2015a) outlines that formative assessment is taken as assessment for learning and it is part of learning. It is done when learners are assessed for their collection of relevant information during teaching process (Motshekga, 2011). This suggests that in formative assessment, teachers help learners in order to understand and make progress during the teaching of physical science curriculum. As a result, all given formative assessment should be aimed at providing special help to learners that are struggling with the physical science curriculum. Therefore, it is necessary for teachers to reflect on this type of assessment for transformation purposes. That is the reason why "assessment needs to be used for learning" (Hoadley & Jansen, 2013, p. 200), in order to develop learners during the teaching process.

In addition to the above, the emphasis of assessment for learning in an interpretive study is described by Khoza (2013b). The study reveals that, formative assessment is part of learning because learners are assessed for their gathering of relevant information during teaching and learning. In other words, teachers should recommend formative assessment as a good assessment strategy for a practical-based subject like physical sciences. This type of assessment engages teachers in a conversation with the learners which allows the assessment to be part and parcel of the teaching and learning process. This involves a lot of feedback from the teacher to the learners.

However, summative assessment "tries to summerise the student learning at some point in time and it has been described as end-of course assessment" (Kennedy et al., 2006, p. 21). Additionally, (Motshekga, 2011) believes that summative assessment is a formal task. Khoza (2015a) further sees summative assessment as assessment of learning. Summative assessments act as a summary of formative assessment so that learners can achieve learning outcomes. It also measures student performance. Studies reveal that summative assessment is the key assessment of all kinds of assessment is education because certification is done through summative assessment marks. This suggests that teachers use summative assessment for grading their learners at the end of the teaching process. As Hoadley and Jansen (2013) believe that, tests and all others activities for assessment are given to learners with an aim to check whether or not the learning outcomes have been achieved.

Moreover, the case study by Khoza (2013a) asserts that summative assessment is a summary of the formative assessment of their students' attainments of learning outcomes for grading purposes. This concurs with Hoadley and Jansen (2013) who indicate that summative assessment gives clear signals to all stakeholders that teaching and learning is occurring in schools. In other words, it is necessary for the physical science curriculum teachers to use summative assessment in order to make learners report. Thus, parents may see if intended curriculum is properly taught as planned. Furthermore, Khoza (2015a) concludes that most of the participants indicate that they follow their CAPS documents for assessing learners. This suggests that teachers should reflect on their teaching practices for their own improvement so that they understand when to use summative assessment and why they should use it.

Continuous assessment is recommended but Kennedy et al. (2006) suggest that continuous assessment often amounts to repeated summative assessments with marks being recorded but little or no specific feedback being given to the learners. In fact, Kennedy et al (2006) also outline the issue of continuous assessment that, it is the combination of both formative assessment and summative assessment. Continuous assessment means "assessment that takes places at intervals throughout the period of learning" (Hoadley & Jansen, 2013, p. 200). Hoadley and Jansen (2013) assert that continuous assessment is about the frequency of the assessment. This suggests that continuous assessment is composed of formal recoded tasks which form continuous assessments (CASS) in the physical science curriculum and make up a certain percentage in the final mark of a learner. This therefore compels teachers to give those formal tasks to learners because it forms part the work that is recoded and moderated.

All the above stated studies indicate the issue of summative assessment, formative assessment and continuous assessment. Most studies were conducted through an interpretive paradigm and case studies as research style. Thus, there is a need for the study to be conducted on teachers at high school in order to reflect of attained curriculum using the critical paradigm. The use of action research style involves teachers to be part of the research for transformation sake. I believe teachers' reflections may be the solution towards the high failure rate of physical science provincially as well as nationally.

Berkvens et al. (2014) articulate that assessment and learning outcomes play a major role in measuring the quality of the curriculum. Assessments depend on the intended curriculum, which is dependent on the implemented curriculum. As a result, the study indicates that what should and should not be assessed depends on the curriculum as intended. Furthermore, the study concludes that assessment always puts pressure on students, parents and teachers as stakeholders in the achieved curriculum. This suggests that teachers should ensure that the reasons for assessment are clear and transparent to stakeholders in order to minimise pressure. The study suggests that an assessment is relevant if a formative assessment is applied to promote learning. Assessment is consistent if testing standards are met. The study further outline that assessment is practical if it tests what is taught and is done from the local context. Assessment is sustainable if tests and exams are conducted according to the intended curriculum.

As a result of the above, discussion from the study by Berkvens et al. (2014) on physical sciences CAPS (2011) does indicate informal or daily assessment as assessment for learning (formative assessment) and also does indicate formal assessment as assessment of learning (summative assessment). However CAPS (2011) does not indicate anything about peer assessment. The CAPS (2011) document outlines that, informal or daily assessment could be prepared via observations, debates, experiment, learner and teacher meetings, and informal classroom communications. CAPS (2011) also assert that formal assessments in tests, involve examinations. CAPS (2011) makes it clear to teachers what to asses and when to assess. The programme of assessment is designed to indicate the type of assessment and the weighting as well. Thus, the assessment in CAPS is relevant, consistent, and suitable. However, assessment in CAPS is not practical since it does not cater for all local contexts like school in rural that have inadequate resources. The table 2.1 provides the summery of the literature on all concepts of curriculum spider web. However, this study intends to balance curriculum spider web concepts with the quality assurance arrange the curricular spider-web concepts as in Table 2.1 below. Further to this, time and location concepts are intertwined to form one concept.

	Concepts	Questions	Propositions	Studies	Gaps identified
1	Rationale	Why are teachers teaching Physical science CAPS?	Personal, Societal/social and Content rationale.	Kehdinga (2014a) Khoza (2015a) Schon (1995) Berkvens et al. (2014) CAPS (2011)	**Data generation:** semi-structured interview versus Reflective activity, semi-structured and focus group discussion.
2	Accessibility	Who is teaching Physical science CAPS	Physical access Financial access Cultural access	Bernstein (1975) DBE (2012) Prinsloo (2005) Dlodlo (2010)	**Research style:** case study versus action research
3	Goals	Towards which goals are teachers teaching Physical science CAPS?	Aims, Objectives Outcomes	Kennedy et al. 2006) Khoza (2015b) khoza (2014b) Khoza (2013a)	**Research paradigm:** interpretive paradigm versus critical paradigm
4	Content	What content are teachers teaching?	Topics experiments Subject knowledge	Kelly (2009) Hoadley and Jansen (2013) Shulman (1987) Booyse and Du Plessis (2008) Berkvens et al. (2014)	**Data generation:** questionnaire and document analysis versus Reflective activity, semi-structured and focus group discussion.
5	Teaching activities	Which activities are you using to teach Physical science CAPS?	Informal assessment activity Formal assessment activity Continuous activity	Talla (2012) Taole (2013b). Khoza (2013a) Carl (2012)	**Research paradigm:** interpretive paradigm versus critical paradigm
6	Teaching role	How do you perceive your role as a Physical science CAPS teacher?	teacher-centred (instructor) learner-centred (facilitator) content-centred approach(assessor)	Georgii-Hemming and Westvall (2010) Sindhu (2012) Revit, Jason, Becker, Jay, Wong, YanTien (2000)	**Research style:** case study versus action research
7	Resources	What material are teachers using to teaching Physical science CAPS?	Hard-ware Soft-ware Ideological-ware	Nakpodia (2013) Meier (1995) Van den Akker et al (2009) Kehdinga (2014b) Khoza (2015) Berkvens et al. (2014)	**Data generation:** questionnaire and observation versus Reflective activity, semi-structured and focus group discussion.
8	Location and time	Where and when are teachers teaching Physical science CAPS?	Teaching hours Teaching space Internet	Coetzee (2009) Meier (2005) Nakpodia (2013) Bennie and Newstead (1999)	**Study phenomenon:** Teachers experiences versus Teachers reflections
9	Assessment	How are teachers assessing learners in Physical science CAPS?	Formative assessment Summative assessment Peer assessment	Hoadley and Jansen (2013) Kennedy et al. (2006) Khoza (2015b) Motshekga (2011)	**Research style:** case study versus action research

Table 2.1: The curricular spider-web concepts, questions, propositions, studies and gaps.

2. 7 Chapter concluding statement

The literature presented here has reflected on how the components of curricular spider-web are used as concepts for the proper curriculum implementation. Issues of rationale for the subject, accessibility, aims, objectives, content, teaching activities, resources, teacher role, and assessment, emerged as the most important issues from the literature. The literature has shown the importance of teachers' reflection as a way of understanding the issues of curriculum. Issues of curriculum like performance curriculum versus competence curriculum and curriculum presentation. As a result, this chapter assists in exploring the reviewed literature of teachers' reflections to research objectives. The next chapter will therefore show how this study will set about answering the research questions by illustrating the research methodology.

CHAPTER 3

Research design and methodology

3. 1 Introduction

The literature reviewed from chapter 2 displayed teacher's reflections of teaching of physical science curriculum in South African school context and around the world. Chapter Two included matters related to curriculum such as intended curriculum, implemented curriculum and achieved curriculum, competence curriculum and performance curriculum. Chapter Two also displayed the ten concepts of the curricular spider-web as the conceptual framework.
Thus, this study intends to achieve the following objectives:

- Understand teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools.
- Explain what informs teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools.
- Explain the lessons that can be learned from teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools.

The study intends to establish the above findings by answering the following questions:

- What are the teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools?
- What informs teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools?
- What lessons can be learned from the teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools?

Hence, the main purpose of this study is to explore teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools. Therefore, this chapter intends to cover the research paradigm (critical paradigm), research style/approach (action research), sampling (purposive and convenience), data generation methods (reflection activity, semi structured interviews and focus group discussion), trustworthiness/authenticity (credibility, dependability, transferability, conformability), data analysis (guided analysis), ethical issues and study limitations. Christiansen et al (2010) defines a research design as a logical sequence that relates empirical data to a study's initial research objectives and conclusion. This chapter therefore intends to give more logical details of the research strategies adopted to address the research objectives and questions as stated above. See figure 3.1 below which gives details of research methodology of this study.

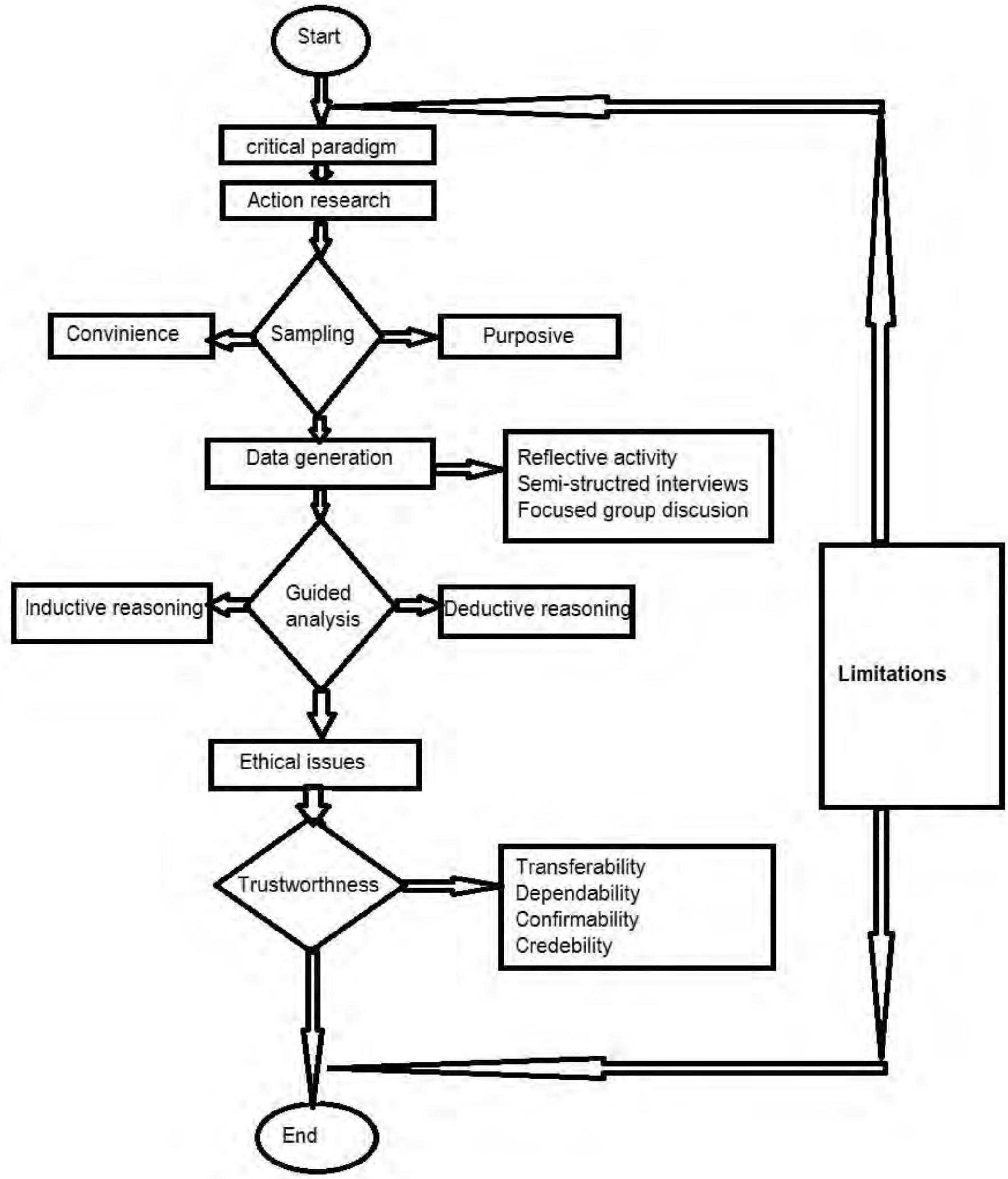

Figure 3.1: Chapter 3 flow chart

3. 2 Research paradigm

Bless and Achola (1990), Brown and Dowling (1998) and Christiansen et al (2010) share the same idea in describing a research paradigm because they believe that research paradigms represent a particular worldview that defines researcher. A paradigm is also taken as way of looking at reality and frames of reference used to organise observations and reasoning. This suggests that each research paradigm is defined by the way it collects data and interprets the findings. A paradigm can therefore be a reflection of a certain set of beliefs about the nature of the reality and how we can know and understand it better for transformational purposes. Furthermore, Creswell (2009) as well as Cohen, Manion and Morrison (2011) believe that it is vital for each study to define its research paradigm because the way we see the world influences the way we research the world. Studies therefore outline various research paradigms which include: the post-positivist, the interpretive and the critical paradigm. Each of these has their way of viewing and interpreting the world. Post-positivists strive for objectivity, predictability, patterning and the construction of laws and rules of behaviour; the interpretive paradigm on the other hand thrives to understand and interpret the world in terms of its actors; and the critical paradigm considers the political and ideological context in order to transform or change society.

Furthermore, this study falls within the critical paradigm. The critical paradigm is described as a paradigm in which a researcher aims not just to describe and understand, but also to enhance justice and fairness in society (Cohen, Manion & Morrison, 2000). Christiansen et al. (2010) also suggest that research in critical paradigm focuses on bringing social change that will help those groups of people who have little power, few opportunities and choices for them based on their sex, race and class. The study outlined how teachers make sense of reality and in-depth understandings, perceptions and reflections of their teaching so that they will be empowered in order to transform or change from their old style of teaching practices. I therefore find the choice of critical paradigm to be the most appropriate in this study on the assumption that in epistemological perspective reality is characterised by social, political, and cultural economic values and history. In fact, we may all have "different beliefs or perceptions, but ultimately, there is only one reality and one truth" (Christiansen et al., 2010. p. 28). Since the research findings from a critical paradigm are subjective rather than objective, they are not replicable (the results would be different if the same study was done in a different context). Thus, the findings of this study are concerned with exposing social injustice and transforming the world and while the results cannot be generalised, other teachers may find meaning that does apply to their lives. As a result, none of the studies discussed did address the phenomenon of this study (teachers' reflection) from a vantage point of critical paradigm. In order to close this gap, a critical paradigm was used in this study.

Furthermore, according to Cohen et al. (2011) critical paradigm intends to emancipate and empower individuals and groups in the society in order to bring social change. This suggests that critical paradigm in this study aims to emancipate physical science teachers in the teaching society/profession. Further to this, teachers were able to make drastic teaching changes (social change) and improved their teaching practices during the implementation of Physical science CAPS. Thus teachers were all aware of what is expected of them during the action research phases. This had influence to teachers being able to make decisions that are concerned with what they do in order to bring changes in their teaching practices.

In addition to the above, this study is qualitative in nature with the intention of study social issues with their natural settings. Christiansen et al. (2010), Mouton (1996) and Creswell (2002) believe that a qualitative approach provides researchers with the opportunity to attempt to understand and describe the ways in which different individuals make subjective sense of their lives. Also, this paradigm attempted to gain an in-depth understanding by asking questions that not only generated information for the study, but also stimulated the participants to reflect on why they engaged in a particular activity and what they need to learn in order to change or transform their own behaviour. This suggests that, as a qualitative researcher in this study, I involved myself in order to deal with socially constructed realities and qualities that are complex in the teaching of the South African physical science curriculum (CAPS). Therefore my task was "to attempt to describe, understand and interpret how various participants in a social setting construct the world around them" (Merriam, 2002, p. 29) for transformation purposes.

Furthermore, Babbie (2004) also asserts that the aim of qualitative research is to promote better self-understanding and to increase insight into the human condition. Thus, in this study, the qualitative approach was appropriate because it gave me the opportunity to understand and interpret the physical science CAPS teachers' lived experiences and reflections in order to change their teaching practice. This approach offered the possibility of a collaborative partnership between me and teachers. I also engaged teachers in a reflective practice during their teaching. According to Cohen et al. (2007) and McMillan and Schumacher (1997) qualitative researchers explores small diverse groups. In light of this, my research focused on six teachers from different schools within the same cluster to enable a multiple-site study because they were best placed to provide a rich source of information for this study.

It must be noted that Christiansen et al (2010) raise the issue of unequal power relationship between the researcher and the participants as questionable and as one of the main shortcomings of the critical paradigm. As a result, in order to address this issue, both I and the participants became researchers in order to critique our teaching practice and to transform us. Furthermore, I did not use the inherent power of being the one conducting this study to use my opinions and perspectives to determine the nature of this study. Getting further I did not use my position as a researcher to influence participants' assumptions, conditions and observations. Moreover, we were all post level one teachers of physical science. As a result, I and the participants experienced the same power relations amongst one another.As a qualitative researcher I therefore adopted an action research style in order to close gaps identified by the literature (Chapter Two). Action research also fit the purpose of the study because of its stages (plan, implement, observe and reflect) which enhances transformation by the participants.

3. 3 Research approach/style

This study employed an action research qualitative approach. Maree (2010) defines action research is a type of research that encourages a collaborative or participative approach in finding solutions to the practical problem experienced by participants. Furthermore, in action research I cooperated with participant to plan and implement an intervention that would alleviate the problem experienced in our teaching of Grade 12 Physical Science CAPS. Evaluation and assessment for effectiveness of an intervention were conducted so that participants (teachers) could reflect on their teaching practices. Christiansen et al (2010) believes that action research in education assumes that teachers know best what is happening in their classrooms. Teachers in the action research process are required to plan, implement, observe and reflect on their practices in order to improve their practices.This suggests that teachers who use action research utilise in-depth analysis of a current problem. The problem was best solved by close collaboration between me as the researcher and teachers as participants since we were all involved in the teaching of physical science curriculum. The action research approach is driven by finding a solution to the problem, as a result, both teachers and I generated data, analysed it, the problem was revised for more data until an agreed solution to the problem was achieved. Therefore, in this study, I assumed that teachers were the best people to participate in order for them to reflect on their teaching. Teachers participated in finding solutions to problems that they experience in their classrooms for transformation and emancipatory purposes in order to improve educational practice.

However, one of the short comings of critical research is the inability to generalise findings. Thus, my study has overcome this limitation by ensuring that the results of the findings were beneficial to those who participated, namely teachers teaching Physical Science CAPS in Ceza ward at Mahlabthini Circuit. Thus, in my case, I did not generalise results to other contexts since that may yield different results but other teachers might find value for themselves in the findings and recommendations from this study. Furthermore, there was a need to overcome one of the other weaknesses of action research specifically that, action research cannot be done by anyone who is not on a particular work/profession. As a result, action research is done by teachers for themselves (Maree, 2007). This suggests that, teachers examine their own classrooms, instructional strategies, assessment procedures and interactions with learners in order to improve their quality and effectiveness of teaching. In addressing this shortcoming, I ensured that this action research was "done by particular people on their own work" (Christiansen et al., 2010, p. 40). This means that the participants of this study are teachers from rural schools in Ceza Circuit who teach Physical Sciences in grade 12.

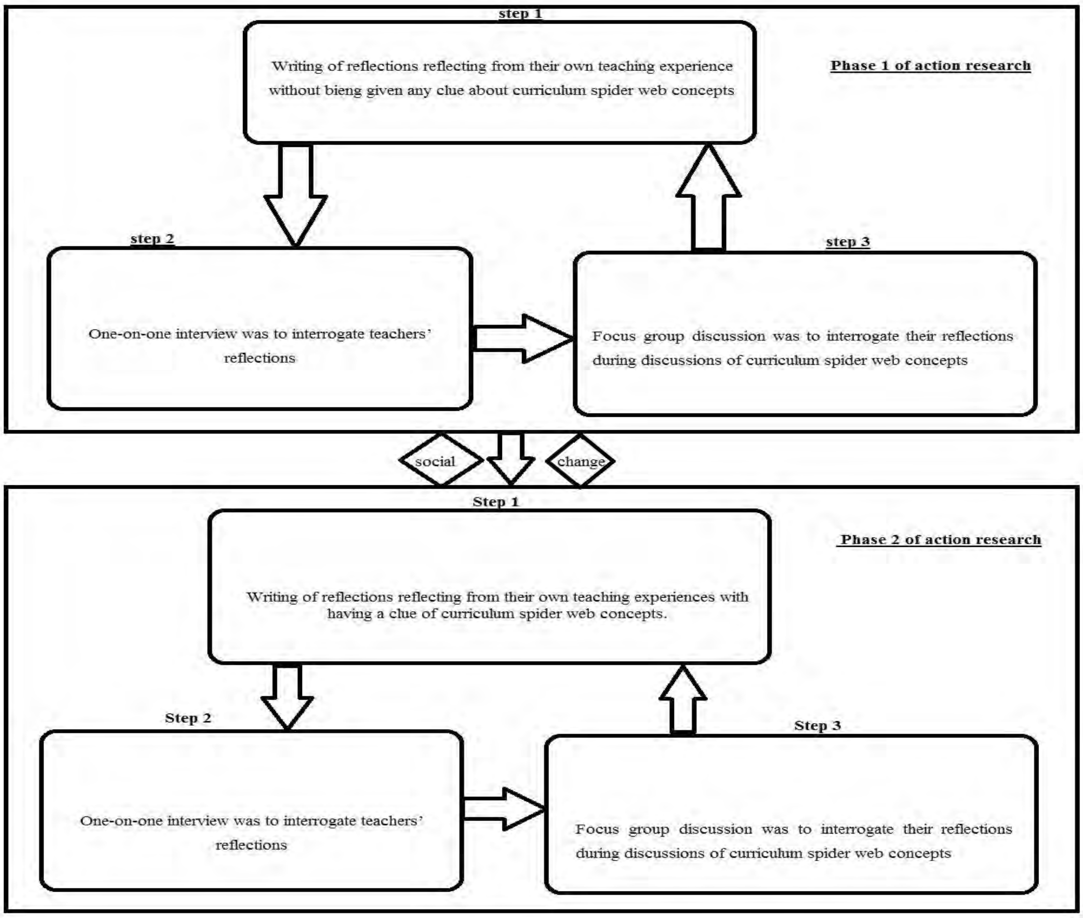

Figure: 3.2 Action research phases

Figure 3.2 above indicates how two phases of action research brought social change to teachers' teaching practices. During the first phase teachers were involved in planning of reflective activity after the identification of the problem. The problem was that their teaching practices (implemented curriculum) is not the same while the intended curriculum is the same. The reflective activity was given to each teacher in order to reflect on the teaching experience based on curriculum spider web concepts. All six teachers had no clue of curricular spider web concepts. The reflective activity gave them an opportunity to unpack their own teaching experience and also become aware of the spider web concepts. After the first step of phase 1, I then further interrogated their reflections one by one by means of one-on-one semi structured interview. This was done to probe and dig more understanding about curricular spider web concepts during their teaching practices. Teachers did not understand some of the concepts and its importance during teaching process. For instance some teachers did not understand that goals mean aims and objectives including learning outcomes. Thus, this changed their perception during teaching process. I therefore, decided to give them different readings which addressed all curricular spider web concepts for them to read in order to bring the understanding and change to their teaching practice. In step 3, we sat down with participants to discuss concepts in details after readings. All teachers analysed and reflected on each spider web concepts. This group discussion led us to plan for second session activity. For instance, teachers were expected to draw a lesson plan for phase 1 for implementation.

Furthermore, during the second phase of action research in step 1, teachers realized that they were oppressed and ignorant of curricular spider web concepts. As a result they started to question what oppressed their teaching practices and their performance in Physical science. Thus, this was an indication that teachers socially changed their perception about teaching practice in class since they understood the importance of spider web concepts such as learning outcomes (goals) and other concepts. Further to this, participants were again given reflective activity to reflect with an understanding of all spider web concepts. Huge improvement from their reflections identified from reflective activity. This suggested change to teacher's perception of their teaching practice. In step 2 during one-on-one semi structured interview, each participant showed clear understanding of all spider web concepts. For instance, some participants were asking why CAPS include learning outcomes (specific skills). Such questions suggested social change during teaching practice of Physical science CAPS. This led us to the focus group discussion (step 3) where all participants had to reflect and also implement the solution (improved lesson plan). As a result, teachers developed phase two lesson plan to indicate a clear understanding on the implementation of spider web concepts during teaching practice. As a result, teachers were able to teach in class using phase two lesson plan. At this stage everyone indicated social change and improvement of using all spider web concepts during teaching of Physical science CAPS. Further to this, phases of action research methodology capacitated me to take note of sampling in this study.

3. 4 Sampling

Sampling is described by Cohen et al. (2011), Bertram (2010) and Christiansen et al. (2010) as the process of making decisions about which people, setting, events or behaviors to observe or study. This is in line with Kerlinger (1964) and Maree (2007) who assert that sampling is done with a specific purpose in mind, specifically to create a representative and manageable number of participants for research. Factors such as expense, time and accessibility often prevent researchers from using the entire population to gain information needed, therefore a small group or a sub-set of the population is used in such a way that it represents the whole group. There are various methods of sampling in educational research, such as probability sampling and non-probability sampling. Probability samples include random stratified sampling, cluster sampling, stage sampling, and multi-phase sampling, whereas non-probability samples includes convenience sampling, quota sampling, and purposive sampling (Cohen et al., 2011). This study used non-probability sampling, specifically purposive and convenience sampling, because it targeted a group of teachers who did not represent the wider population and had no intention of generalising findings.

3. 4.1 Purposive sampling

This study used purposive sampling in order to include teachers with whom I was familiar, who were from the same environment (Ceza Circuit), and who taught physical science curriculum while working for the South African Department of Basic Education (DBE). Purposive sampling helped me to make specific choices about which teachers to include in the sample. The Grade 12 Physical Science CAPS teachers were chosen for this action research because they dealt with this curriculum and are still teaching physical science CAPS in their schools. I targeted teachers from schools in Ceza Circuit since this region does not represent the wider population (Collins & Hussey, 2009). This selection simply represents itself since I did not want to generalise the results beyond the group sampled. Thus, via purposive sampling, teachers included had different qualifications (academic and professional) and different levels of experience which gave me the possibility for varied responses. I selected teachers who were currently attending a content workshop run by the Department of Education in order to build a sample that is satisfactory to their specific needs and teaching practice**.** I ensured that six teachers would be able to reveal different reflections of their teaching of the physical science curriculum. The six schools were also chosen purposively because these schools offer Grade 12 Physical Science CAPS as one of their subjects.

Furthermore, purposive sampling also provides greater depth and focuses on people that are information rich (Cohen et al., 2011). As a result, all selected teachers possessed a certain qualification in such a way that their participation in this study was trusted in order to provide data that shall address the answers to the research questions. Table 3.1 below shows the participants who were purposefully sampled for this study. Alphabetical codes from A-F were used to refer to six participants whereas numbers from 1-6 were used to indicate their schools. For example, A1 would denote participant A from school 1 and so forth.

Participants	**Experience**	**Subject**	**Grade**	**Age**	**Qualification**	**Gender**	**Race**
Participant A1	3	Physical Science	10-12	27	M+3	Female	African
Participant B2	2	Physical Science	10-12	25	M+3	Male	African
Participant C3	6	Physical Science	12	29	M+4	Male	African
Participant D4	4	Physical Science	12	32	M+4	Male	African
Participant E5	4	Physical Science	10-12	30	M+4	Female	African
Participant F6	7	Physical Science	12	34	M+4	Female	African

Table 3.1: Study participants' profiles

However, Cohen et al. (2011) assert that one of the weaknesses of purposive sampling is that I cannot select any participants without specific knowledge of the phenomenon studied. In order to address this weakness in this study, I opted to sample those teachers who were knowledgeable about the teaching of Grade 12 Physical Science CAPS. Those teachers were able to reflect on their teaching practice because of their teaching profession. Furthermore, I knew that this group of teachers did not represent the wider population and only represented Ceza Circuit.

3. 4.2 Convenience sampling

Sampling was also convenient because I chose teachers from 6 out of 12 schools from Ceza Circuit who were easily and conveniently accessible and available since I taught with them in the same cluster. Christiansen et al. (2010, p. 43) describes convenience sampling as “choosing a sample which is easy for the researcher to reach”. As a result, in the case where there were two teachers teaching physical science per school, I selected the most experienced teachers who were all in post level one of employment category . I opted to include this group since they have taught physical science for a period longer than two years. I anticipated that these teachers were matured and were less likely to be resistant to the research and would not leave the study because they were matured and committed. The schools that were selected for this study are conveniently located for easy access by me as a researcher. Cohen et al (2011) assert that this type of sampling does not represent any group apart from its self; therefore this type of sampling does not seek to generalize findings. I have therefore opted to use convenience sampling in this study in order to maximize the time available for research and to ensure easy access to participants. According to Cohen et al. (2007) the researcher may use or choose to sample from those who are easy to access. As a result I decided to use six teachers who taught from six high schools which were easily accessible during and after school hours. Travelling to these schools and making appointments with teachers of these schools was easy. These schools were no more than fifteen kilometres apart which made it easier for data generation.

While convenience sampling does make data generation easier, it also poses its own problems. As Cohen et al. (2011) indicate one of the disadvantages of convenience sampling is to choose participants that do not clearly represent the population. Thus, to address this issue, I only selected six teachers who were easily accessible. The sample did not represent the whole population but only Ceza Circuit and findings were not generalised. As a result, data generating methods played a big role in this study.

3. 5 Data Generation Methods

The study adopts three techniques in data generation/production: an open-ended questionnaire for participants’ reflective activity; one-on-one semi-structured interviews; and focus group semi-structured discussion.

3. 5.1 Reflective activity (Open-ended questionnaire)

This study adopted reflective activity as the first method of data generation from participants (teachers). Studies by Cohen et al. (2011), Valli (2009) and Milam (2008) describes the "Teacher Reflection Activity" as a written activity that asks teachers to complete a short series of questions about the phenomenon studied. These studies used reflection phenomenon so that participants could give attention to their experiences and behaviours in order to enhance meaning to their future actions and decisions. This suggests that, in this study, teachers were given a chance to look back to their teaching practices in order to improve and change their behaviours during the implementation of the physical science curriculum. I designed a reflective activity that was in line with the concepts of the curricular spider-web as a conceptual framework used in this study (chapter 2). The activity requested that teachers reflect on set questions as represented in table 3.2 below.

Concepts	**Questions**	**Teachers are expected reflect based on:**
Rationale	Why are you teaching Physical science CAPS?	Personal rationale (pedagogical), Societal/social rationale and Content knowledge rationale.
Accessibility	Who is teaching grade 12 Physical science CAPS?	Physical access Financial access Cultural access
Goals	Towards which goals are you teaching Physical science CAPS?	Aims, Objectives Outcomes
Content	What content are you teaching Physical science CAPS?	Topics Experiments/practical work Subject knowledge
Teaching activities	Which activities are you using to teach Physical science CAPS?	Informal assessment task Formal assessment task Continuous activities
Teaching role	How do you perceive your role as a Physical science CAPS teacher?	teacher-centred (instructor) learner-centred(facilitator) content-centred approach(assessor)
Resources	What material are you using to teach Physical science CAPS?	Hard-ware Soft-ware Ideological-ware
Location and time	Where and when are you teaching Physical science CAPS?	Teaching hours(time allocation) Teaching space/venue
Assessment	How are you assessing learners in Physical science CAPS?	Formative assessment Summative assessment continuous assessment (CASS)

Table 3.2: The research concepts, questions and expected responses

Based on Table 3.2, Teachers are expected reflect based on propositions identified on each concepts from the literature (chapter 2).

Question One was expected to generate the teachers' answers on why they were teaching physical science CAPS as framed by the three propositions as personal, social and content rationale articulated by Berkvens et al. (2014) and Van den Akker et al. (2009). Thus, within the personal rationale teachers were expected to express passion about teaching, in social rationale teachers were expected to show community involvement in their teaching practice and on content rationale teachers were expected to display their school knowledge as based on the teaching qualification and other studies.

Furthermore, Question Two expected teachers to respond on accessibility which was divided into physical, financial and cultural access as proposed (Berkvens et al., 2014). The reflection question is who are you teaching? Physical access refers to the ways of accessing schools like the kind of transportation they use. Financial access implies any funds they use in order to access schools. Cultural access involves other issues like sport, art, political, religious and social beliefs.

Question Three focused on establishing the teaching goals. Teachers were expected to give answers based on the aims, objectives and learning outcomes (propositions) of teaching the subject (Kennedy et al., 2006). Within this framework, aims describe the long term goal and are referred to as the broad statement that a teacher intends to cover during teaching. Objective is the short term goal. Specifically it what the teachers intends to cover during the teaching process (Khoza, 2013b). Learning outcomes are statements learners should achieve by the end of a lesson (Kennedy et al., 2006).

Question Four established what was being taught, meaning the content provided to learners. The aim of this question expected teachers to respond based on topics, subject knowledge and experiments as propositions (Hoadley & Jansen, 2013). As a result, topics include all content on Mechanics (paper 1) and chemistry (paper 2) from CAPS documents as the intended curriculum.

The aim of Question Five was to establish the type of activities given by teachers to the learners. The fifth question asked teachers to describe the learners' activities. This question was proposed from the literature in Chapter Two as part of the informal assessment tasks, formal assessment tasks and continuous assessment tasks (CAPS, 2011). Informal tasks were referred to as observations, discussions, demonstrations, class-work and home-works. Formal tasks describe content taught by teachers with the expectation of later grading learners. This includes projects, experiments, controlled test and examinations. Continuous assessment tasks describe the recurring process of both the informal and formal assessments.

In Question Six, teachers were expected to generate their reflections on how they perceive their role as Physical Science CAPS teachers as framed by the three propositions: teacher-centred (instructor), learner-centred (facilitator) and content-centred approach (assessor) (Khoza, 2015a).When a teacher acts as an instructor, he/she gives strict instructions to be followed by learners. If a teacher asks learners to search for their own information and return with it to class for discussion, they were then taken as facilitators. Teachers became assessors when they taught prescribed content and then established a means to assess (either through class work, homework, test and examinations) a learner's understandings.

The main purpose of Question Seven was to allow teachers to openly reflect on the kind of material and resources they use during teaching. As a result, teachers were expected to respond on resources according to the hard-ware, soft-ware, and ideological-ware resources as propositions. Thus, hard-ware resources were any tool or machine used in education; soft-ware resources were any material used together with hard-ware to display data; and ideological-ware describes those elements of teaching that cannot be seen or touched, such as teaching methods and content (Khoza, 2013a)

Question Eight establishes two concepts of the curriculum spider-web, namely the location and time; teachers were expected to respond on venues they use to teach physical science like classrooms and laboratories. Internet space sought to explore the nature of internet usage in schools. Regarding time, teachers were expected to reflect on time allocated to physical science content as prescribed by the CAPS document.

Question nine was expected to generate the teachers' reflections on how they assess learners as framed by the three propositions as formative assessment, summative assessment and continuous assessment in order to evaluate and make progress in learners' understandings of their content (Kennedy et al., 2006). Formative or informal is taken as assessment for learning and summative or formal assessment is taken as assessment of learning (Khoza, 2013a). This suggests that in formative assessment teachers were expected to talk about those activities, such as tests and examinations that helped their learners' progress. Summative assessment is a summary of the formative assessments of students' attainments of learning outcomes for grading purposes (Khoza, 2013a). Teachers were expected to reflect on assessment task like control test and examinations. Teachers were expected to reflect on formal tasks they do with learners which contribute to the learners pass percentage (continuous assessment).

The reflective activity was administered in two phases as Cohen et al. (2011) believes that in a reflective activity, researchers design and provide questions to ensure participants are honest in their responses. This suggests that the issue of honesty is one of the drawbacks in the reflective activity because one cannot be sure the participant was honest enough in giving answers to the reflective activity. However, in this study I ensured honesty by giving participants more time, on their own, to respond to questions on the curricular spider-web concepts and encouraged participants to be very professional in their responses and very brief in giving a concise account of their teaching practices on the teaching of physical science curriculum. In this reflective activity, I also advised participants to respond to the set of questions in order to reflect on their past experiences and present situation and what they could do to improve their behaviour going forward. This data generation method was found suitable because I was eliminated from interacting directly with the participants. This gave them the freedom to respond honestly.

This activity was given to the six Grade 12 Physical Science CAPS teachers to do it on their own for a period of two weeks' time. This happened in order to allow teachers to feel free to reflect on the teaching of physical science curriculum around the ten concepts of the curricular spider-web without the influence of my presence. Teachers were given two weeks in which to reflect and complete this activity. I collected the responses from participants three days in advance of the one-on-one semi-structured interviews so that I could familiarise myself with their experiences and prepare further.

3. 5.2 One-on-one semi-structured interviews

The study used one-on-one semi-structured interviews as the second method of data generation after reflective activity and it was conducted in two cycles. McMillan and Schumacher (2006) define semi-structured interviews as open response questions to obtain participants' meanings and how they make sense of important events in their lives. "It does allow for the probing and clarifications of answers and it usually requires participants to answer a set of predetermined questions" (Maree, 2007, p. 87).

I found one-on-one semi-structured interviews to be the most suitable for this study because it allowed the six participants to give more detailed response. I began by asking a teacher to tell an autobiographical story which invoked the teaching experiences of physical science CAPS before asking specific questions related to the reflective activity and new ones for probing purposes. Participants were able to use the language they are comfortable with in their responses (English and isiZulu) in order to fully understand their context. The interviews were conducted in an informal manner in order to allow participants to become comfortable and relaxed which ultimately yielded more honest data.

Christiansen et al. (2010, p. 68) assert that, "Interviews generate large amounts of textual data such that when one transcribe, a one hour interview can become a 15 pages of text". Thus in this study, in overcoming this drawback, I did not transcribe data during interviews in order to avoid distortion of information during transcription. As a result, I recorded all interviews with a cell phone, so that I later had the opportunity to transcribe data directly from the recorded source. I also held interviews during break times or after school, depending on the needs of each participant, in order to avoid disturbance from school hours.

The data gathered from the semi-structured interviews elaborated on the data generated from the reflective activity in order to boost the depth of the individual responses on the set questions. Christiansen et al. (2011) believe that researchers require skills to probe and establish follow up questions. As a result, I possessed needed propping skills and flexibility to make a follow up question in following the participants' story of reflection. This is evident in the interviews I conducted; the order of question of curriculum spider-web concepts discussed between me and participants was determined by how the participants responded rather than how I had them on paper. I always ensured that I was as neutral as possible in order to avoid bias which would influence the data generated. Furthermore, Pinar (2004) emphasises the issue of currere as autobiographical experience, this suggests that semi-structured interviews should allow for the development of in-depth accounts of experiences and perceptions with individuals in their teaching experiences, and "interviews provide rich qualitative data that give insight into the teachers' biographical history" (Coetzee, 2009, p. 41). As a result, I used interviews as powerful data generating tool not only for data collection but also as a means to promote social interaction amongst participants in order to support transformation and development purposes.

In addition to the above, Cohen et al. (2007) concur with studies by both Msomi (2013) and Zulu (2010) who state that semi-structured interview are a dominant instrument for research during data generation because interviews can ensure high-quality data when people are approached professionally. As a result, in this study I gave serious attention to the interview process. I conducted all interviews in the presence of the participant which made it easy for me to give clarity to unambiguous questions. This made it easy for participants to voice out their views, opinions and concerns during the interview process. Furthermore, Maree (2012) and Cohen et al. (2007) assert that interviews assist in closing the gaps created in other forms of data collection. Thus, I have used interviews twice in order to give more time to the participant's reflections on the teaching of physical science.

Khoza (2015b) and Zulu (2010) believe that interviews involve social interaction exercise which includes issues of power relations which can influence participants in their response. This suggests that the position of the researcher may have a negative impact on the interviews process. In addressing this kind of weakness in the study I did not use my rank as the researcher, but instead positioned myself as a physical science teacher so that participants felt more comfortable with the interview process.

Furthermore, even though interviews are an expensive data generation method in terms of time and preparation, I managed to minimise costs by using my cell phone as a recording instrument and used any available classrooms to conduct interviews. Furthermore, I used two interview phases to allow for more detailed data generation. A week after each phase of the semi-structured interviews were administered, I therefore organised a focus group discussion which included all participants.

3. 5.3 Focus group discussion

A focus group discussion was utilised twice for data generation in this action research in order to yield an analysis of the teachers' reflections. Furthermore, Cohen et al. (2011) states that in focus group interviews, the researcher facilitates group discussions by actively encouraging group members to interact with one another. As a result, I conducted a focus group discussion at one of the school which is central to all six participants. The focus group discussions focused on our reflections of the teaching of Grade 12 Physical Sciences curriculum (CAPS). The participants were able to discuss and share concepts of the curricular spider-web as experienced through their teaching practices. Silverman (2013) believes that, in focus group discussions, the researcher actively directs group discussions by encouraging group members to cooperate with one another. Thus, I directed the discussion among six teachers in such a way that I provided space for participation and included myself in findings from our reflections and the ways we could tackle challenges we met during the implementation of the physical science CAPS.

This action research required me to use a set of all the three methods in two phases/circles. As a result, I actively facilitated only two intervals of focus group discussion in each phase using the same kind of set of questions asked from a reflective activity for about 45 minutes. This allocated time (45) assisted in enhancing cooperation in order to avoid only one voice being heard. Focus group discussions were conducted twice in order to facilitate the transformation process. Teachers were expected to learn in the first phase in order to see challenges so that they will improve in the second phase.

I ensured that both discussions were conducted in a quiet classroom on Saturday. Cohen et al. (2011) opines that a well conducted focus group discussion can uncover unique reflections on the concepts studied due to the atmosphere in which the data is generated. This suggests that data generated in group discussions are different from those generated during interviews and reflective activities because data represents the group understanding and not the individuals within a group. It is for this reason that I included this method of data generation which was conducted in an environment that suited all six participants (classroom). Cohen et al. (2011) suggest status differentials as one of the drawbacks of a focus group discussion but I ensured that all participants were all post Level One to avoid dominance.

Silverman (2013) and Cohen et al. (2011) believe that accurately collecting data after each data collection method can be difficult. As a result, I recorded focus group discussion to ensure that the data analysis was based on an accurate word-for-word data. Recording took place only after the consent of the participants has been granted. From this, the recorded discussion was transcribed at a later stage to attain qualitative data. Table 3.3 shows how data was generated.

	Objective 1	**Objective 2**	**Objective 3**
Why data was generated?	Understand Teachers' reflections of the teaching of grade 12 physical sciences CAPS in rural schools at Ceza Circuit.	Explain what informs Teachers' reflections of the teaching of grade 12 physical sciences CAPS in rural schools at Ceza Circuit.	Explain the lessons that can be learnt from Teachers' reflections of the teaching of grade 12 physical sciences CAPS in rural schools at Ceza circuit
What is the research strategy?	The reflective activity, one-to- one Semi-structured interviews and the Focused group discussion.	The reflective activity, one-to- one Semi-structured interviews and the Focused group discussion.	The reflective activity, one-to- one Semi-structured interviews and the Focused group discussion.
Who were the sources of data?	Six grade 12 Physical Science CAPS teachers from different schools	Six grade 12 Physical Science CAPS teachers from different schools	Six grade 12 Physical Science CAPS teachers from different schools
How often were data generated	All data generating methods were done in two phases or cycles: Firstly, teachers were given the teacher reflective activity which they had to complete for the researcher to collect after 2 weeks Secondly, one-on-one semi-structured interviews were conducted for 30 minutes each participant	All data generating methods were done in two phases or cycles: Firstly, teachers were given the teacher reflective activity which they had to complete for the researcher to collect after 2 weeks Secondly, one-on-one semi-structured interviews were conducted for 30 minutes each participant	All data generating methods were done in two phases or cycles: Firstly, teachers were given the teacher reflective activity which they had to complete for the researcher to collect after 2 weeks Secondly, one-on-one semi-structured interviews were conducted for 30 minutes each participant

	And lastly a focused group discussion was also conducted for an hour.	And lastly a focused group discussion was also conducted for an hour.	And lastly a focused group discussion was also conducted for an hour.
Justification of this plan for data generation.	The teacher reflective activity authorised the physical science teachers to reflect on their teaching practices in the absence of the researcher allowing them the freedom to express themselves One -on-one semi-structured interviews and the focused group discussion enhanced the researcher to get detailed and in-depth understanding of teachers' reflection of implementing the physical science curriculum.	The teacher reflective activity authorised the physical science teachers to reflect on their teaching practices in the absence of the researcher allowing them the freedom to express themselves One -on-one semi-structured interviews and the focused group discussion enhanced the researcher to get detailed and in-depth understanding of teachers' reflection of implementing the physical science curriculum.	The teacher reflective activity authorised the physical science teachers to reflect on their teaching practices in the absence of the researcher allowing them the freedom to express themselves One -on-one semi-structured interviews and the focused group discussion enhanced the researcher to get detailed and in-depth understanding of teachers' reflection of implementing the physical science curriculum.

Table 3.3: Data generation plan

The data generation plan in Table 3.3 assisted me to generate relevant data in each phase of the three data generation methods. After data generation I undertook a stage of data analysis in order to analyse produced data.

3. 6 Data analysis

Christiansen et al. (2010) assert that the step a researcher must take after gathering data is data analysis. Guided analysis refers to the predetermined categories of the theory of curriculum spider- web (Van der Akker et al., 2009). It is this theory that underpins the deductive coding of the data. These studies take qualitative data analysis as a process of creating sense from data in terms of the participants' definitions of the situation, noting patterns, themes, categories and regularities. Thus, for the purpose of this study, data analysis included some vital tasks which include analysing data. This means to check what do the data says and interpret it in order to present the analysis to the readers.In these quality data analysis, I extracted explanation, understanding or interpretation from the qualitative data collected from teachers' reflection and their context.

According Christiansen et al. (2010) qualitative data analysis can be categorised into two approaches, one is an inductive approach and the other is a deductive. Therefore, in this study, I adopted the guided analysis which included both inductive and deductive reasoning as a process. Guided analysis is defined by Dhunpath and Samuel (2009) as categories that are developed as a priori and categories are modified through interaction with data. I considered that the data analysis process for this study started at the beginning of the project. I also considered that the research participants were always aware that I was trying to express and make sense of their activities. This is evident in the cell phone recording of our discussions and from all three kinds of data generation methods (sources of data) where I continually probed deeper to help teachers and myself understand what it is that they reflected on as guided by the conceptual framework of this study (curricular spider web).

Furthermore, Christiansen et al. (2010) assert that in inductive reasoning, we start with the raw data that we have generated from the participant and from there detect patterns in order to draw conclusions. For results, I started by detecting patterns from the data generated through the reflective activity, semi-structured interviews and focus group discussion. At the end, I developed conclusions which were based on these results. I therefore enhanced inductive reasoning by ensuring that the categories did emerge from the data generated by participants. In addition, I used a guided analysis approach by employing the concepts of the curricular spider-web as the conceptual framework in order to categorise the data generated. To achieve results, I began with a set of categories, which were then mapped into data needed for the purpose of deductive reasoning. Furthermore, I utilised open coding which is defined by Cohen et al. (2011) as the new label that a researcher attaches to a piece of text to describe and categorise that piece of text. Thus, I used guided analysis in order to assist in coding participants' responses and that enabled me to reveal the conclusions of this study. Data analysis activities include data reduction, data display and conclusion drawing (Christiansen et al., 2010). As a result, for the sake of data reduction, I then reduced recorded data from all three data generating methods (reflective activity, semi-structured interview and focus group discussion). I started by reading the transcribed data from the original sources (recording device) and from there wrote down ideas that came to my mind as I read the data. From there I established the consistent topics or themes (descriptive term) which emerged from the data. Following this, I compiled the list of topics together (classification) from the different data in order to have the sets of topics. This assisted me to classify and categorise data into the same set of topics. Thus, I abbreviated these topics in order to make codes.

However, Cohen et al. (2011) asserts that one of the weaknesses in data analysis is the issue of data transcription. Transcription could be time consuming and expensive for those researchers who hire a scribe to transcribes data. This could also distort the results as the scribe may record data into their own words. In addressing this issue I wrote the transcriptions myself, directly from the recording devices during my own spare time. This gave me an opportunity to select vital data from the original source rather than a mediated transcribed source. Furthermore, I considered the principle of *primum non nocere* (do no harm to participants), and as a result I considered all ethical clearance issues for the purpose of accomplishing this study.

3. 7 Ethical issues

Ethics are defined by Cohen et al. (2000) and Christiansen et al. (2010) as a matter of principled sensitivity to the rights of others. Ethics also puts more emphases on the respect for human dignity. Furthermore, ethics in research are vital, especially with research that involves humans and animals because all studies follow certain ethical principles which involve the rights of participants to be protected from any harm that might occur. These studies clarify that ethics are situated which implies that they have to be interpreted in a specific local situations. Thus, in this study, I requested permission to conduct the research in writing from Department of Basic Education via the Mahlabathini circuit Manager and Zululand Regional Director, refer to annexure B. Thus, permission to conduct this study was granted by the Director of Zululand district on behalf of Basic Department of Education which enabled me to access the six chosen schools, refer to annexure D.

In addition to the above, I also asked and was granted permission by the Principals of the selected schools which opened access to the physical science teachers, refer to annexure A. After permission was granted I visited each participant in their school to ask them for permission to participate in the research study. Cohen et al. (2011) emphasises ethical principles that include autonomy, non-maleficence and beneficence.

Fortunately, all participants agreed to take part in this study. Once participants had agreed, I briefly explained the purpose of the study to each participant and informed all participants in writing and verbally of their rights to confidentiality, anonymity and status as voluntary participants. From this I asked participants to sign a consent form, refer to refer to annexure C and provided them with a study outline (Cohen et al., 2011) which included an explanation of the procedures to be followed; description of the participants' risks; reiterated that participants would receive no financial benefit; listed advantages to the participants; made a commitment to answer any queries concerning the procedure, established that there were no right or wrong answers; and an instruction that participants were free to withdraw consent and to discontinue participation at any time. Participants were given the chance to remain anonymous (alphabetical coded names were used) and promised a copy of the report once the study was concluded. They were assured that audio recording would only be conducted with their consent during data generation process. I explained to them that their rights to privacy was assured by using pseudonyms instead of their real names and participants were made aware that any information they provided would be confidential. In addition, I confirmed that information provided by them would only be used in this study and not for any other irrelevant purposes.

Furthermore, the research proposal for this study was taken through the university approval stages which included writing a proposal and assigning of a supervisor. After proposal submission, the supervisor suggested corrections which helped guide the focus of the study, and ensured the study attained its objectives. The research proposal was then submitted to Humanities and Social Sciences Research Ethics Committee for ethical clearance by the university, which was approved, and an ethical clearance certificate was granted which was valid for three years, refer to refer to annexure E. This certificate assures the readers that all necessary precautions were taken to ensure the rights of the participants of this study.

However, one of the disadvantages in ethical issues is that of deception. Deception may occur in not telling participants the truth that they are being researched and are taken as participants of a particular study (Cohen et al., 2011). In addressing this weakness, I ensured participants were aware of the research by implementing consent forms. Betrayal is also considered a weakness in unethical research. Betrayal occurs when confidential data is publicly disclosed by the researcher with an aim of embarrassing participants, "one of the research methods that is perhaps most vulnerable to betrayal is action research" (Cohen et al., 2011, p. 95). In overcoming the issue of betrayal in this study, I promised participants that all the information gathered would be kept by myself and the supervisor at Edgewood Campus Library and that the data would be destroyed after five years. As a result, it could not be publically or privately used against them.

3. 8 Trustworthiness

The elementary epistemological principles for qualitative study involves trustworthiness which is detailed by Cohen at al. (2011) as associated to principles of truth, value and neutrality of the research. The term trustworthiness refers to the way in which the enquirer is able to persuade the audience that the findings in the study are worth paying attention to and that research is of high quality (Guba & Lincoln, 1994). Furthermore, Guba and Lincoln (1994) suggest that paying attention to the following dimensions will increase trustworthiness in a qualitative study: credibility, transferability, dependability and conformability. Therefore, I ensured trustworthiness of the study by ensuring that the above stated dimensions are adhered to as follows:

3. 8.1 Transferability/applicability

Cohen at al. (2011) describes transferability as applicability of the research findings to another context and this definition is in line with Christiansen et al. (2010) stating that transferability is defined as to the extent to which the findings can be transferred to another context. Thus, in this study, I have ensured transferability by enhancing that the accurate findings of the study were beneficial and applicable to similar contexts as this study. As a result, the findings from teachers' reflections from the six teachers can be transferred and applicable to other teachers in other contexts. For the fact that teachers' reflections are based on the concepts of curricular spider-web in their teaching practice of physical science, this suggest that teachers surely did reflect on CAPS document, annual teaching plans and lesson plans. This ensured that the findings of this research can be compared with contexts outside of the Ceza Circuit since all teachers are compelled to use CAPS in their teaching of Grade 12 Physical Sciences.

3. 8.2 Dependability

According to Cohen at al. (2011), dependability refers to the consistency of research findings. In order to ensure that there is trustworthiness in this study; Cohen et al. (2011) and Neuman (2006) assert that validity in qualitative research is embedded on the principle of dependability. Dependability is about giving correct and direct information in the study. In order to do this I offered concise evidence of data generated by including direct quotations to allow readers to assess the findings for them. The use of literature review and the CAPS document assisted in ensuring that the research findings were based on concrete evidence and allowed for informed judgment of the teaching of physical science CAPS by Grade 12 teachers.

The fact that teachers were met in two phases (during reflective activity and one-on-one semi-structured interview) ensured that gaps identified during the reflective activity were identified and addressed during the focus group discussion. The instruments used had ten questions determined by the curricular spider-web principles. In addition, a tape recorder was used to enable accurate transcription. I therefore ensured that transcribed data was given to participants in order to confirm the data as a true reflection of their interviews. I also went back to participants to ensure that the findings of the research were dependable (trustworthy) and that the results were consistent with information gathered through the multiple methods of data generation (reflective activity, one-on-one semi-structured interview and focus group discussion). I then compared collected data with each instrument to avoid being biased while direct quotations were used to provide evidence of data produced. Dependability was achieved by ensuring that all six participants were appropriate to the purpose of the study and that results were accurately stored.

3. 8.3 Conformability

The process of conformability is concerned with whether the findings reflect the experiences and ideas of the participants and it assures that the position of a researcher does not influence the findings (Shenton, 2004). As a result, I ensured my research was trustworthy by demonstrating that if it was carried out in a similar context, the research findings would reflect the reflections and ideas of the teachers teaching physical science CAPS. As a result, all participants received the same set of questions through different data generation methods. Data generation was conducted in such a way that the findings presented the true reflections of the participants (teachers) since I used my cell phone to record sessions. Finally, the findings were confirmed by participants as true reflections of their responses. As the qualitative researcher, I acknowledged biasness and possible circumstances that might have affected the data in any way and have ensured that I did not use my power as a researcher to influence the findings.

3. 8.4 Credibility

Guba and Lincoln (1994) as well as Kerlinger (1964) describe credibility as ensuring that findings reflect the 'reality' and lived experiences of the participants and the true value of information derived from the discovery of human reflections. In ensuring credibility in this action research, I used common triangulation methods; triangulation refers to collecting data from a number of different sources (Cohen et al., 2011). As a result, the use of three data generation methods (reflective activity, one-on-one semi-structured interview and focus group discussion) and recording of data facilitated credibility of generated data in this study. For the sake of trustworthiness and authenticity, I used the curricular spider web as the conceptual framework to guide and frame all data generation processes so that all participants used the same tool of data gathering.

3. 9 Limitations and possible problems

Due to the fact that I am also a Grade 12 Physical Science teacher in the same ward (Ceza), I acknowledged that, this position alone clamped a certain bias and a personal interest in conducting this study. However, I did not raise any opinions, knowledge and experiences during the course of the study. In order to overcome this, I allowed participants to provide their own data, without my influence, during our data generation methods. One of the limitations, like all other qualitative research, is that this study is small scaled and thus its findings and results are subjective, personal and contextual and cannot be generalised. However, it is possible for readers to use the findings from this study for the sake of transferability rather than generalisation.

3. 10 Concluding statement

Chapter 3 elaborated on the research design and methodology of this study. As a result, this chapter described the research paradigm, research style, sampling, data generation methods including data generation plan, trustworthiness, data analysis, ethical issues and research limitations. All these methods provided the research protocol and provided direction for how this should be conducted in order to meet or achieve its intended objective. Weaknesses of each method were also addressed. Furthermore, the teacher’s reflections on the teaching of Physical Science CAPS were explored using the above methods.The following chapter will look at data analysis of the data generated through the described research methods. The main focus of the following chapter is to unpack research findings and discussions by following the data analysis described in this chapter.

CHAPTER 4

Research findings and discussions

4. 1 Introduction

Chapter 3 provided the research design and methodology used in this study. This chapter takes us a step further in order to reveal the results of the data that was generated through the three research methods (reflective activity, one-on-one semi-structured interview and focused group discussion). The findings are presented through the curricular spider-web conceptual framework selected for this study. The curricular spider web concepts are taken as themes in this chapter in order to present the data. Six participants from six different schools were used for data generation and are here referred to as participant A1, B2, C3, D4, E5 and F6 as detailed in Table 3.1 in the previous chapter. Thus, in presenting the data, direct quotations from participants will be included to support the research findings and discussions.

4. 2 Findings and discussions

Cohen et al. (2011) assert that it is vital to have a project specific plan of analysis that will guide the data analysis in order to achieve the intended research objectives. As a result, Table 4.1 shows how the findings are presented by following the curricular spider-web themes in order to guide data analysis as described in Chapter Three. Findings are followed by discussions that are linked with related literature. Reflections are separated by levels: Firstly, the technical level of reflection; secondly, the practical level of reflection and thirdly, the critical level of reflection. The levels of reflection are then aligned to each category.

Themes	Questions	Levels of reflections	Categories per level
Rationale	Why are you teaching Physical science CAPS?	1. Technical level 2. Practical level 3. Critical level	1. Personal rationale (pedagogical), 2. Societal/social rationale and 3. Content knowledge rationale.
Accessibility	Who are you teaching grade 12 Physical science CAPS?	1. Technical level 2. Practical level 3. Critical level	1. Physical access 2. Financial access 3. Cultural access
Goals	Towards which goals are you teaching Physical science CAPS?	1. Technical level 2. Practical level 3. Critical level	1. Aims, 2. Objectives 3. Outcomes
Content	What content are you teaching in Physical science CAPS?	1. Technical level 2. Practical level 3. Critical level	1. Topics 2. Experiments/practical work 3. Subject knowledge
Teaching activities	Which activities are you using to teach Physical science CAPS?	1. Technical level 2. Practical level 3. Critical level	1. Informal assessment task 2. Formal assessment task 3. Continuous activities

Teaching role	How do you perceive your role as a Physical science CAPS teacher?	1. Technical level 2. Practical level 3. Critical level	1. teacher-centred (instructor) 2. learner-centred(facilitator) 3. content-centred approach(assessor)
Resources	What resources are you using to teach Physical science CAPS?	1. Technical level 2. Practical level 3. Critical level	1. Hard-ware 2. Soft-ware 3. Ideological-ware
Location and time	Where and when are you teaching Physical science CAPS?	1. Technical level 2. Practical level 3. Critical level	1. Teaching hours(time allocation) 2. Teaching space/venue 3. Internet
Assessment	How are you assessing learners in Physical science CAPS?	1. Technical level 2. Practical level 3. Critical level	1. Formative assessment 2. Summative assessment 3. continuous assessment (CASS)

Table 4.1: Themes, questions, level of reflections and categories from curricular spider-web

Levels of reflections indicate experiential learning which is complementary to action (Percy, 2005). As a result, participants involved themselves in all stages of action research in order to encourage critical thinking at all levels of reflections. Communication and participatory learning among participants supported their understandings of the teaching practices of the physical science CAPS. Action research is an emancipatory process (Zuber-Skerrit, 1992) which occurs in two phases in this study. Thus; participants participated in all stages of the action research which includes, planning, implementation (action), observation and reflection.

Furthermore, during the first phase of the action research, the planning done by participants included transformation; techniques like brainstorming was utilised during group discussion in order to develop a lesson plan to be used during the implementation/teaching stage of this action research. The participatory sharing of ideas and perspectives, based on their reflections, were encouraged in this emancipatory approach to planning and design of a first lesson plan (Figure 4.1). During the implementation stage, participants used the lesson plan that was developed during the planning stage to teach their learners. Furthermore, observation and reflection were conducted with participants in order to identify any additional needs that were to be addressed in the second phase of action research. The main objective of this stage (observation and reflection) of the action research was to allow individual participants to input on an improved lesson plan after implementation stage. The reflection stage enabled participants to develop a second lesson plan as indicated in Figure 4.2.

Phase one lesson plan

Lesson Topic: *electric circuit*

Time: *1 hour each period*

Location: *grade 12 classroom*

Rationale	Accessibility	Goals
1. Personal rationale *'I enjoy teaching physical science CAPS'* 2. Societal rationale *'I want to give back to community'* 3. Content knowledge *'No reflections '*	1. Physical access *'I walk to school from near cottages'* 2. Financial access *'I pay R1000 for a staff car to school* 3. Cultural access *'No reflections'*	1. Aims: *'Equip learners with scientific skills'* 2. Objectives: *'Enhance learners to understand problem solving skills'* 3. Learning outcomes: *'In do not know anything about learning outcomes'*

Content	Teaching activities	Teaching role
1. Topic *'Electricity, acid and base, ect'* 2. Experiments *I give learners experiments to be done for CASS* 3. Subject knowledge *No reflections'*	1. Informal activity *'I give class works and home woks as part of daily work'* 2. Formal activity *'Learners write control test and prescribed'* 3. Continuous activity *'No reflections '*	1. Teacher-centred *'I instruct learners during teaching'* 2. Learner-centred *'I facilitate my teaching in groups'* 3. Content-centred *'No reflections'*

Resources	Assessment
1. Hardware *'I use textbooks, chalk board and computers to watch DVDs'* 2. Software *'I use powerDVD software, power point for slides and internet to download PDF files'* 3. Ideological-ware *'No reflections'*	1. Formative (informal) assessment *'I use short test , assignments to assess learners'* 2. Summative(formal) assessment *'I asses learners through control test(March, June and Trial) and examinations'* 3. Continuous assessment *'No reflections'*

Figure 4.1: Phase one lesson plan

Phase two lesson plan

Lesson Topic: *electric circuit*

Time: *1 hour each period*

Location: *grade 12 classroom*

Rationale	**Accessibility**	**Goals**
1. Personal rationale *'I enjoy teaching physical science CAPS'* 2. Societal rationale *'I want to give back to community'* 3. Content knowledge *'I have studied PGCE that equipped me with teaching methods '*	1. Physical access *'I walk to school from near cottages'* 2. Financial access *'I pay R1000 for a staff car for transport'* 3. Cultural access *'...girl learners absent themselves because of cultural functions that takes place around Ceza ward'*	1. Aims: *'to know about electric circuit '* 2. Objectives: *'to be aware of series connection and parallel connection'* 3. Learning outcomes: *'to assemble an electric circuit '*

Content	**Teaching activities**	**Teaching role**
1. Topic *'Electricity, acid and base, ect'* 2. Experiments *I give learners experiments to be done for CASS* 3. Subject knowledge *'Possession of content knowledge makes it easy for me to impart electricity skills to learners... '*	1. Informal activity *'I give class works and home woks as part of daily work'* 2. Formal activity *'Learners write control test and prescribed'* 3. Continuous activity *'I experiment to learner for CASS '*	1. Teacher-centred *'I instruct learners during teaching, aims and objectives becomes the priority'* 2. Learner-centred *'I facilitate my teaching in groups and I use learning outcomes to drive my lesson'* 3. Content-centred *'I first use grade 11 basic content to set the test that will invoke concepts on laws on motion...'*

Resources	**Assessment**
1. Hardware *'I use textbooks, chalk board and computers to watch DVDs'* 2. Software *'I use powerDVD software, power point for slides and internet to download PDF files'* 3. Ideological-ware *'I also use both teacher-centered and leaner centered approach alternatively in my teaching of physical science CAPS'*	1. Formative (informal) assessment *'I use short test, assignments to assess learners'* 2. Summative(formal) assessment *'I asses learners through control test (March, June and Trial) and examinations'* 3. Continuous assessment *'I give projects and experiments to learners'*

Figure 4.2: Phase two lesson plan

4.2. 1 Why are you teaching Physical science CAPS?

- ***Theme 1: Rationale***

During the first phase of reflection, participants reflected on the curricular spider-web questions which sought to establish the rationale behind teaching of the physical science CAPS. Mostly, participants reflected on only one or two elements of the three reflective categories. Furthermore, B2, C3, D4 and F6 outlined that they were teaching physical science CAPS in rural schools in order to help learners (societal rationale). B2 said '*I am teaching physical science CAPS because I enjoy it and I want to give back to my community learners from rural schools by equipping them with necessary skill and knowledge for physical science CAPS'.* A1 and E5 also agreed with this reason but they added that they are well experienced and enjoy teaching the physical science CAPS (personal rationale). E5 said *'I find it easy to teach and I enjoy teaching physical science CAPS because its content is well organised, thus I know what to teach by following the annual teaching plan or work schedule'.*

On the other hand, during the second research phase participants were aware of all three reflective rationale categories, as seen when participant A1 said *'since I am a qualified teacher holding BSc. Degree and PGCE, I then enjoy teaching physical science CAPS… I teach physical science CAPS in order to help grade 12 learners to pass well so that they can get bursaries for their tertiary level of study…'* In addition,D4 stated that, '*at first I did not enjoy teaching physical science CAPS since I did not know that one day I [would] be a teacher, but now I do enjoy it since I am paid monthly, this makes my life easy and as a result, I want to instill science to our learners from rural schools… I have studied PGCE [which] equipped me with teaching methods.*' The reflections by B2, C3, E5 and F6 were in line with those of A1 and D4. During the second phase, all participants showed an expansion in their reflections because they reflected on all three rationale categories (personal/pedagogical rationale, societal/social rationale and content knowledge rationale) as depicted in the lesson plan (implemented curriculum) in Figure 4.3. This suggests that participants were learning in order to better understands the curriculum via the curriculum spider-web and that they were involved in all process of action research (namely, planning, implementation, observation and reflection).

The above accounts (see Figure 4.2) from the first phase of reflection indicates that passion (personal rationale) of teaching physical science CAPS played a major role, followed by the societal rationale (lesson plan). This suggests that most teachers in Phase One reflected through the technical and practical level of reflection. None of the teachers reflected at a critical level of reflection (content knowledge rationale) which required an awareness of knowledge sources that promote critical thinking in one's field. Van Manen (1977) as well as Zeichner and Liston (1987), explain that in technical level reflections teachers deal with technical application of educational knowledge in a learning environment so that it would be easy to achieve learning outcomes. As a result, technical reflection is therefore dependent on competence curriculum which is determined by preset learning outcomes and by personal opinions, local every day or general knowledge and oral conversation (Hoadley & Jansen, 2013). This suggests that teachers reflected mostly with personal rationale, and without any concentration or deep thinking (limited critical thinking). In other words, teachers used everyday knowledge to give their Phase One accounts.

In addition to the above findings, it is clear that disadvantaged African teachers from deep rural schools, in most cases, use everyday knowledge because they do not develop themselves by studying further since the Department does not fund them. The report by NEPI (1993) revealed that during Apartheid most black teachers were deprived of an education that would instill school knowledge. This has prevented them from being able to reflect critically on the transformation of their teaching practices in their subjects. This suggests that the Apartheid government disadvantaged most black teachers. Today, this still highly influences teachers' reflections on the rationale for teaching physical science CAPS. The way in which the curriculum is planned is stilled influenced by the politics of the day, and the thoughts of the most powerful groups in our society (Bernstein, 1975). When the Apartheid government was in power, the intended curriculum represented their ideology to oppress black South Africans so that they would not be able to use school knowledge, which has in turn influenced the thinking of teachers teaching physical science CAPS. Curricular methodology for blacks during Apartheid was driven by Christian ideology and was encouraged by old traditional practice, which does not enhance critical thinking (Hoadley & Jansen 2013). This suggests that since teachers were themselves taught through a curriculum that encourages everyday knowledge, they may find it too complicated to implement school knowledge, performance based, Physical Science CAPS. As a result, CAPS may not be sustainability for quality assurance purposes (Berkvens et al., 2014).

Furthermore, teachers' accounts in level one reflection in the first category (personal rationale) showed that CAPS (intended curriculum) is prescribed and organised which is why teachers enjoy teaching physical science CAPS. Teachers use annual teaching plans (work schedule) that direct their teaching. Moreover, Stenhouse (1975) sees curriculum as intention, plan or prescription where all intended content to be taught is prescribed. This suggests that CAPS is also in line with Bernstein's performance model of curriculum where the focus is on the subjects being taught. Furthermore, Stenhouse (1975) sees curriculum as a process where the intended curriculum provides a selection of content to be taught and teachers decide how it should be taught. From the teachers' accounts then, the CAPS documents (intended curriculum) provide teachers with the physical science content to be taught by teachers, but the CAPS documents do not indicates how this content should be taught (ideological-ware). Teachers have options to make decisions about the sequence of teaching which determines their roles (Stenhouse, 1975). This suggests that that teachers need to think critically while teaching in order to fully understand their roles. On the contrary, in Ralph Tyler's product approach to curriculum, the focus is on high levels of understanding of the subject (physical science CAPS content). As a result, personal rationale is powerful as it drives teachers to teach subjects even engaging the process of critical thinking ideological-ware (Khoza, 2015b). However, according to the teachers' reflections, personal rationale is powerful to black teachers since they mostly use everyday knowledge as compared to South African ex-Model C teachers who use school knowledge which is based on their educational background (NEPI, 1993).

Furthermore, some teachers did reflect on the second level, societal rationale in the second level. In the practical level of reflection (societal rationale) teachers are concerned with the principles that guide their teaching practices; in this level teachers are concerned with the aims and objectives to be attained which also addresses the political dimensions of the intended curriculum (Van Manen, 1977). In this level of reflection, teachers want to practically see their learner's access to tertiary level study which is in line with the physical science CAPS' aim that learners "access higher education" (CAPS, 2011, p. 4). In other words, teachers are teaching physical science CAPS to apply what they studied from university in order to help learners to get results that would enable them to have access to tertiary education.

Furthermore, Percy (2005) is of the view that transformation and empowerment is a result of the critical level of reflection. Thus, teachers started to transform during the second phase of the action research process from level one and two to level three reflections. This is evident in the second lesson plan created during the group discussion of the action research. During critical level reflections (level three) teachers were concerned with the influence of external factors on their classroom teaching practice. These factors include power, relations and equity. Teachers in this level used critical criteria which encourage them to reflect upon the ethical and moral aspect of teaching (Zeichner & Liston, 1987). Teachers took time to gain an understanding of their profession as teachers in phase one before they gave reflections on content knowledge rationale in phase two (see figure 4.3). As a result, two teachers indicated that they possessed academic qualifications (BSc. degrees) and that they had gained a PGCE for teaching methods (ideological-ware). These qualifications indicate that teachers did not initially intend to take teaching as their profession in order to teach physical science CAPS. They started to realise they had become professional teachers while they were in the field of teaching via obtaining teaching methods (PGCE). Some teachers indicated that they are teaching physical science CAPS because they get paid monthly, this suggest that some teachers are teaching because they need money at the end of the month. In this respect, imparting knowledge to learners, through their qualifications, had become a second option to them. These reflections indicate that teachers do not do justice to the teaching of physical science CAPS, which is why Grade 12 Physical Science results (achieved curriculum) have declined in the year 2014/2015 (DBE, 2014).

Schmidt (2012) stipulates that a teacher instructs, according to the intended curriculum (CAPS), specific skills and content to learners. This suggests that, teachers (curriculum implementers) should teach physical sciences CAPS (enacted curriculum) because (rationale) they want to convey skills to learners and attain the CAPS stated aims and objectives. CAPS (2011), however, does not state the reasons why educators teach physical science CAPS. Additionally, Taole (2013) concludes that teachers are change agents in the curriculum review process as they are the curriculum implementers and their perspectives and ethics will determine the success or failure of any curriculum evaluation. This suggests that if those teaching physical science are not well qualified to teach physical science CAPS, the curriculum may not be successfully implemented as in intended. Thus, subject advisers and curriculum Department officials should play a major role in a teacher's qualification. Teachers during the second phase of action research have realised the importance of a qualification in the teaching of the physical science CAPS. This is evident when Blumer (1969) as well as Zeichner and Liston (1987) conclude that reflection is a social object resulting from the interpretation of input from others rather than the self. Thus, during the second phase of reflection, teachers were given different studies to read in order to extend their minds (school knowledge) on the teaching of physical science CAPS.

4.2. 2 Who are you teaching Grade 12 Physical science CAPS?

- ***Theme 2:*** **Accessibility**

The participants did not reflect on the cultural access category but claimed to understand physical and financial access. B2, E5 and F6 reflected in a similar way when it comes to physical access category such that E5 said '*For me, I simply walk to school from very close cottages…*' C3 responded, '*I am using a staff car to get to school and I pay R1000, this is too much for me to pay monthly… I cannot stay next to school because there is no electricity… staff vans used on gravel road for a long distance to get to school and I always feel tired before I start teaching* '. A1 and D4 also paid money for staff vans in order to get to school.

However, on the second phase of reflections participants seem to better understand all categories. For instance, E5 revealed that '*during school days, half a class of girl learners absent themselves because of cultural functions that takes place around Ceza ward'*. B2 stated that the '*school community culture does negatively affect my teaching because cultural functions are done during school days…* '. A1, C3, D4, F6 reflections concurred with that of E5. Furthermore, '*the issue of transport is problematic especially when one is not staying close to school and it costs a lot…* ' all participants had the same opinion as E5 on the physical category and financial access category.

Phase One reflections indicated that the participants were only aware of physical access and financial access. B2, E5 and F6 reflections, as indicated in lesson plan one, clearly showed that it is easy to access the teaching environment because they stayed in cottages next to their schools and would walk to school. This indicates that teachers are afraid to walk long distances, and instead used staff cars (vans), because they arrive at school exhausted, and this has a negative impact on teachers. This condition makes it clear that teachers may not actively teach physical science CAPS if they stay far from schools. These findings suggest that teachers from rural school felt limited and oppressed (powerless) by the Department because there is no transport provided for teachers to access schools in deep rural areas.

Furthermore, the issue of resources plays a major role in the teachers' access to schools (Bernstein 1975). This suggests that some teachers are highly attracted by the resources available in 'ex-Model C' schools. In this respect, the achieved curriculum may always decline since most competent teachers prefer to be employed by well-resourced schools rather than under-resourced schools in rural areas. This is evident when DBE (2012) reported that Funda Lushaka bursary holders (teachers) resist going to teach in deep rural areas but they prefer urban areas. Thus, the nature of accessibility alone may have a negative effect on the achieved physical science curriculum. Furthermore, the performance approach to curriculum encourages demarcated learning sites (physical access) such as school classrooms and laboratories, but in the competence curriculum teaching occurs anywhere (Bernstein, 1975). This suggests that irrespective of whatever approach the curriculum adopts, teachers should be able to implement the teaching of CAPS.

In addition to the above, from the findings, teachers spent a lot of their own money (financial access) travelling to school. This suggests that teachers are deprived of a rural allowance (funds) that might assist them to pay for transport to school. This clearly indicates that the absence of financial support from the Department remains an accessibility barrier in the teaching of the physical science CAPS in schools.

Dialogue and participatory action research leads to the process of critical reflection (Brookfield, 1986). This suggests that during the second phase of reflection, via group discussions, most teachers realised the effect of cultural access (critical level of reflection) on the teaching of physical science CAPS. As a result, teachers' accounts during the second phase of reflection revealed that cultural access remains a barrier in the teaching of physical science CAPS in rural schools since learners, especially girls (gender), did not attend school or extra classes set by teachers because of cultural activities they had to attend. Gender implications in curriculum policies are not taken into consideration and there are no policies to specifically promote the education of girls (NEPI, 1993). Educational policies must promote gender equality in order to ensure an inclusive approach to the successful teaching of the curriculum (Simonds, 2014). This suggests that the intended curriculum (CAPS) should address the issue of sexism in school so that teachers' teaching will not be influenced by either girl or boy learners in class. Furthermore, the impact of socio-economic factors on learners plays a major role in education (Dlodlo, 2010). As a result, community culture sees cultural activities as being as important as the teaching of the physical science curriculum. While the teachers' reflections do indicate that community culture does not stop them from teaching, it still serves to disrupt them due to the high rate of absenteeism. From their reflections, there are no cultural differences based on race, language and religion in their schools.

Furthermore, it was noted from the findings that most of the teachers teach learners from the isiZulu speaking community, whereas the language of teaching and learning (LOLT) is English (CAPS, 2011). As a result, language has a high impact on the learners' results (attained curriculum) since they use English as first additional language in their examinations. Learners' home language is isiZulu and is not used during the teaching and learning process. Teachers even indicated that it is hard for learners to construct a single sentence in English, which heavily influences their ability to understand and pass the physical science CAPS. Thus, teachers indicated that during implementation of the phase two lesson plan, goals were taken into consideration and code switching (English to isiZulu) used to simplify some of the concepts.

4.2. 3 Towards which goals are you teaching Physical science CAPS?

- ***Theme 3: Goals***

Most of reflections from participants during the first phase were on the objective category, few were on the aims category and none reflected on the learning outcome category. A1, C3, D4 and F6 only reflected on objectives (specific purpose). A1 indicated that *'....to equip learner with investigative skills to physical (paper 1) and chemical phenomenon (paper 2)… I* *think aims and objectives are the same.'*D4 added that, '*I enhance learners to understand scientific problem solving skills…*' C3 said, *'I do not know anything about learning outcomes from [the] CAPS document'*. F6 also concurred with these reflections, while B2 and E5 had similar reflections such that, B2 believe their roles was '*…to assist learners to attain good results for easy access to tertiary level of study'.*

However, during the second phase, teachers showed much improvement, participants reflected very well on both categories but missed the usage of action verbs, especially in the leaning outcome category. F6 said, '*when I teach learners, I also expected them to do something by the end of each lesson but I do not tell them before we start the lesson, it remains my own thinking what they should achieve. For instance, when I am teaching electric circuit, learners are expected to assemble circuit components in series or in parallel'.* D4 pointed out that *'lesson plans assist me to indicate the purpose when I am teaching a particular concepts in class, such as when I am teaching [the] acids and bases chapter, I first introduce learners to the basic definitions in acids and bases (aim), so that I will make learners to understand or be familiar with Arrhenius theory and Lowry-Bronsted theory (objective) which will lead my learners to distinguish between acid and a base and also be able to identify conjugate acid base pairs (outcomes)'.* All other participants had similar reflections but some participants found it harder to differentiate between aims, objectives and learning outcomes.

During the first phase of reflection, teachers' accounts in this theme (Goals) indicated that they only reflected at a technical (aims) and practical level (objectives). Teachers did not reflect in level 3 of reflections which involves the learning outcomes category. Two out of six teachers reflected on first category (aims) and the majority (four) reflected on the second category (objectives), none of them reflected on the third category (learning outcomes). Some teachers indicated that, they clearly do not understand the difference between aims, objectives and learning outcomes. This alone brought confusion to teachers who taught physical science CAPS. However, both Kennedy et al. (2006) and Khoza (2015a) portray good and understandable definitions of these goals: aims are defined as a broad general statement of teaching intentions written from the teachers' point of view of the content; objectives are the "specific statement of teaching intention" from the teachers' perspective (Kennedy et al., 2006, p. 5); and learning outcomes are what learners need to know, demonstrate, and understand by the end of each lesson. Furthermore, Khoza (2015a) believes that aims provide the broad teaching purpose of a subject. This suggests that the manner in which the subject should be taught would depend on the stated broad aims of each subject from the intended curriculum (CAPS). For instance, physical science CAPS (2011, p. 4) states that “this curriculum aims to ensure that children acquire knowledge and skills in ways that are meaningful to life… to equip learners with necessary skills and values for participation in the society...”

According to the teachers reflections, goals (aims and objectives) depicted in the phase one lesson plan seem to be taken directly from the intended curriculum (CAPS document) because these aims and objectives are not content specific but are subject specific. In other words they are generalisable when it comes to content. This suggests that any teacher can use those aims and objectives but that they are not specific to any particular content/subject. As a result, teachers’ accounts shows that they copy the CAPS instructions from the policy document, without any understanding, in order to write subject specific aims. It also indicates that this process is not critical since it does not contribute towards transformation (Percy, 2005). Thus, in order for teachers to reflect critically and be transformed and empowered, they should be involved in the curriculum design process (Khoza, 2015a).

In fact, research findings indicate that some teachers were not aware CAPS is driven by aims and objectives (performance curriculum). This suggests that CAPS (intended curriculum) is a performance based curriculum. Hoadley and Jansen (2013) outlines that the focus in performance curriculum is on the subject to be taught; there are no concrete rules which state how this content should be taught but teacher-centred appears to be the teachers’ most preferred ideological-ware. This suggest that those teaching physical science CAPS should use school knowledge, instead of using general knowledge, to drive their lessons as there are stated aims and objectives to be achieved by teachers in the CAPS document. Furthermore, the majority of teachers were not aware that, those objectives are stated in the CAPS documents. Furthermore, when it comes to learning outcomes they were all blank in their reflections. This indicates that teachers do not read the CAPS document.

However, even if there were no learning outcomes stated in the CAPS document teachers should take the initiative to and generate learning outcomes for themselves because these drive the lesson (Khoza, 2015b). It is for this reason that teachers' have included the learning outcomes in the second phase of this action research (Figure 4.3). However, during the second phase of action research teachers started to realise the importance of aims, objective, and especially the inclusion of learning outcomes in the teaching of physical science CAPS. This indicates that transformation has taken place and transformation needs strategic plans. As a result, teachers' empowerment enabled them to develop the second lesson plan for their teaching practices. This indicates a higher level of critical reflection as Percy (2005) believes that when teachers reflect at a higher level, they are more likely to change their teaching practice. This suggests that teachers, during the second phase of this action research, have participated and reflected on their teaching of the physical science curriculum. Thus, teachers did emancipatory learning in order to change their teaching practice by considering aims, objectives and learning outcomes in the second lesson plan which was subject specific (electricity).

Furthermore, Donnelly and Fitzmaurice (2005), Khoza (2014a) and Berkvens et al. (2014) bring to the fore the issue of learning outcomes in their studies. These studies conclude that learning outcomes are on learners' intentions in order to fit in learner's perspectives as per intended curriculum (CAPS). The above stated studies further outline that learning outcomes are generated according to Bloom's (1971) taxonomy of learning, namely: knowledge, comprehension, applying, analysing, synthesising and evaluating. Studies further articulate that the correct usage of Boom's (1971) key verbs, listed according to taxonomies under the cognitive domain, leads to the correct formulation of learning outcomes. This suggest that learning outcomes are measured or observed from students' performance, and as a results teachers showed an improvement when using the specific and observable keywords from Bloom's (1971) taxonomy (define, explain, critique, assemble, evaluate (see figure 4.3). In other words, during the second phase of reflections, understanding the formulation of learning outcomes assisted teachers to reflect on learning outcomes in their teaching practices.

Furthermore, teachers' reflection showed that they were not aware that in the CAPS document there are stated aims, objectives and outcomes. Aims are presented as general South African curriculum aims but are not specific to content. Objectives are presented as specific aims for Grade 10-12 teachers teaching CAPS content and outcomes are presented as examples of the skills to be covered in the teaching content (Khoza, 2015b). Transformation starts from the micro-level of curriculum implementation (Brookfield, 1986). This suggest that teachers' transformation started in the phase two lesson plan since they were more involved in the formulation of aims, objectives and learning outcomes. The reflections in phase two lesson plan indicate that teachers were reading various readings given to them during the second phase of action research which outlined definitions, understanding and the formation of goals. Furthermore, Berkvens et al. (2014) suggest that what teachers should teach depends on aims and objectives which can outline the society (society values), subject (curriculum reflection) and student (creating opportunities). Thus, in South African physical science curriculum, general aims are relevant since they do address the issue of society, subject and student. Practically, aims/objectives cannot be applied since they are not specific to the content stated from CAPS document. This confuses those who are teaching physical science. As a result, there is a possibility that CAPS may not be practically implemented.

Furthermore, CAPS (2011) states four cognitive levels from the CAPS document. However, teachers' findings indicate that they only know key words for the formulation of learning outcomes but that they don't have any understanding of Bloom's taxonomy and the levels (Van den Akker et al., 2009). This suggests that there is a problem when it comes to the teaching of physical science CAPS, based on learning outcomes. As a result, the South African curriculum will not be sustainable in future because there are no stated learning outcomes: intended, implemented and attained learning outcomes. Thus, teaching without observable learning outcomes will not be successful. As a result, "students learn the content and they are then assessed according to their achievement of the learning outcomes, which indicate whether or not learning took place." (Khoza, 2015b, p. 11). This suggest that if there are no stated learning outcomes from the CAPS documents then there is no clear chance that CAPS, as an intended curriculum, will not yield excellent results (achieved curriculum). According to Berkvens et al. (2014) there will be no consistency since the physical science CAPS document does not align content with learning outcomes and this leads to confusion among curriculum implementers, which also plays a major role in preventing change.

Teaching without learning outcomes cannot yield good result in physical science, this is evident when Khoza (2013b) concludes that learning takes place when modules are driven by learning outcomes because they are observable and measurable in terms of what students are expected to know and be able to do at the end of a lesson. This suggests that teaching physical science CAPS without learning outcomes may not be sustainable.

I addition to the above, there is curriculum differentiation as far as gender is concerned. It is believed that some subjects like science and mathematics can only be done by boys rather than girls because they are challenging (NEPI, 1993). This suggests that if teachers can deny goals in their teaching of physical science CAPS, some girl learners may be deprived of the right to do the subject of their own choice, as a result goals ensure that the issue of gender is adhered to and goals also accommodates both girls and boys in science. The findings indicate that teachers were empowered based on gender relation to the curriculum. This is evident in both lesson plans since they do not specify if these goals are orientated towards girl or boys. In other words these goals do not differentiate between boys and girls during the teaching of the content.

4.2. 4 What content are you teaching in Physical Science CAPS?

- ***Theme 4: content***

In the first phase of reflection, B2 and C3 reflected the same way as E5, because E5 said, '*I teach both physics as paper 1 and chemistry as paper 2, this paper makes up 150 marks each and when combined is 300 marks. I do experiments as detailed in CAPS document*'. C3 added that, '*I find it difficult to teach physics part, I rather keep more time in chemistry because I am familiar with it'. However,* A1 said *'I have covered first and second term work: work, energy and power; projectile motions; momentum; organic chemistry and chemical change* '. D4 and F6 also agreed.

In the second phase, D4 said '*I always cover all six chapters in physical science CAPS: matter and materials, chemical systems, chemical change, mechanics, wave sound and light, electricity and magnetism*' B2 added that '*I always ensure that keep more time drilling learners on chapters that have high marks like chemical change and organic chemistry in* *paper 2, mechanics and electricity & magnetism in paper 1*'. C3, E5, A1 and F6 all agreed with the above reflections, but F6 added that, '*possession of content knowledge makes it easy for me to teach learners the content easily and also demonstrate the experiments…*' This suggest that there is transformation from participants in the second phase because they were able to list all topics covered in physical science CAPS and able to categorise which topics are in paper 1 and paper 2. They even indicated that they possess content knowledge of physical science CAPS.

All teachers during the first phase of the action research were able to reflect on the subject topics category (paper 1 (P1) and paper 2 (P2)) and experiment category (practical task) which indicates level 1 and level 2 of reflection. Teachers were able to reflect on the topics stipulated in CAPS (2011) as follows: matter and materials (P2); chemical system (P2); chemical change (P2); mechanics (P1); waves, sound and light (P1) and electricity and magnetism (P1). Participant's reflections indicate that some are comfortable in teaching P1 but some are more comfortable with P2 and vice versa. This suggests that if teachers are good at one part, learners may also be good at only one part. This does not create consistency in the intended teaching of the physical science curriculum. Williams et al. (2003) concludes that some students are interested in either physics topics or chemistry topics because of the influence of teachers whose primary qualification may be in either physics or chemistry.

Additionally, Shulman (1987) as well as Hoadley and Jansen (2013) believe that a teacher is a scholar who must know all parts or topics of the subject. This suggests that teachers serve as a primary source of content topic of a subject during teaching practice. As a results, teachers should familiarise themselves with the content topic in the CAPS document (curriculum-as-planned). Teachers should know how to teach the detailed content in annual reaching plan (curriculum as implemented) in order to enhance good results (curriculum as achieved) in the teaching of physical science CAPS. Furthermore, participants stated that experiments were done according to the stated topics as recommended by the CAPS documents. In fact, the Physical Sciences CAPS (2011) state that all systematic topics, content, concepts and skills to be taught by teachers – including all prescribed practical activities or experiments. This then suggests that CAPS is a performance based curriculum and as a result, teachers find it easy to teach physical science content.

Furthermore, the curriculum is based on the values of social justice and equity. In such a way, during the implementation process, teachers should foster the values of human rights, anti-racism and anti-sexism, critical thinking and problem solving (DBE, 2005). This indicates that during the teaching of physical science, content teachers should address the issues of race and gender, and promote problem-solving skills and critical thinking. This is evident during the second phase of action research in the implementation of the second lesson plan, because the content is not offered according to boys or girls. On the other hand, subjects are constructed and taught around male or female orientated where the content are filled with gender (NEPI, 1993). However, teachers' findings indicated their teaching practice was not influenced by gender. As a result, transformation and emancipation prevailed since teachers used their lesson plans to teach the content that is not demarcated according to race and gender, thus both boys and girls, black or white are taught the same content as prescribed from CAPS document. Findings from the second phase indicate that teachers critically reflected well since they were able to address the issue of gender during the teaching of the physical science CAPS.

In addition to the above, teachers' accounts during the second phase of reflection indicated that almost all teachers were able to prolifically reflect on all three categories (topics, experiments and subject knowledge). This alone indicates an improvement, and suggests that teachers were transformed and empowered in their teaching of physical science CAPS. A teacher must possess the content and the curriculum knowledge needed to enhance smooth teaching practice (Shulman, 1987). This suggests that when teachers do not have enough pedagogical content knowledge, they may influence the high failure rate (achieved curriculum). Thus, the teaching of the physical science CAPS relies on the way that teachers teach the content and on the way teachers create interest of content among the learners. The teachers' findings conclude that subject topics and content knowledge are the key proposition in this theme (content).

Furthermore, teachers were also aware of the curriculum knowledge outlined by the CAPS documents. In other words, teachers were aware of topics of the content to be covered in the physical science curriculum because they able to teach content in paper 1 and paper 2. The performance approach to the curriculum suggests that on curriculum content, the Department decides which subjects to teach and what subject topics and content knowledge to teach (Hoadley & Jansen, 2013). This brings to the fore the issues of quality assurance of CAPS content as Berkvens et al. (2014) further assert that any content in a curriculum should prepare learners for local life, future education and the world of work. While physical science CAPS content is relevant to learners since it prepares them for tertiary studies, it does not however train learners for the working environment since more time is given to theory than experiments. Some schools find it difficult to implement experiments due to the local context barriers. This suggests that CAPS does not fully consider relevance, consistency, practicality and sustainability in determining the quality of content.

4.2. 5 Which activities are you using to teach Physical Science

- ***Theme 5: teaching activities***

Most participants reflected on the informal activity category during the first phase. For instance, C3 said that, '*I give homework and class work to learners taken from the textbook called Solution for All'*, while B2 added that, *'I normally use previous question papers to set weekly and monthly test and I also give them class work to check if they have understood certain concepts taught, like Doppler effect in sound, wave and light'*. A1, F6 and D4 agreed with these reflections but E5 reflected on both informal and formal activity category. E5 said, '*I use class works, homework, control test and exams from the KZN Provincial Department of education written per term… I prefer control tests since they are done for grading purposes'*. All participants did not make any comment about continuous activities.

However, during the second phase all participants agreed with D4's reflections who said, '*I give both class work and home works from study and master textbook as informal task to learners irrespective of their gender, but for reporting purpose I use control test and examinations, I also do not forget to give my learners investigations, projects and experiments for continuous assessment (CASS)*'. F6 added that, '*I give only two prescribed task (experiment and external control test) to learners for CASS*'. This may suggest that most participants were transformed during the second phase of action research.

Teachers reflected on level one of reflection where they were only looking at informal activities as well as formal activities (second level of reflection). It was clear from teachers' findings that they were not aware of the continuous activities (CASS). CASS contributes a certain percentage to the final mark of a learner. The findings declare that formal tasks, like control test and examination, are the key activities when compared to others (experiments and informal activities) because they are done with a grading purpose. This suggests that formal activities measure the performance of each learner, per subject, at the end of chapter, term or a year. Taole (2013) also adds that teaching activities will determine the success or failure of any curriculum. As a result, the findings place a higher focus on formal activities.

Teachers indicated that they use class work, homework and monthly tests as activities taken from various textbooks. Informal tasks are not used for grading purpose, but instead to check if learners understand the content taught (Curriculum News, 2010). Thus, informal tasks are undertaken by teachers in order to prepare learners to write formal tasks which include controlled tests and examinations set by the Department. This suggests that activities play a major role in successfully implementing the physical science CAPS curriculum. As a result, teachers should be aware of all kinds of activities that may benefit the learners. Teachers should use authentic activities which link students to real-world relevance so that student will actively participate in those activities (Khoza, 2013a). In other words, those teaching physical science CAPS must link their activities to real-world relevance so that learners may see the need to do both formal and informal activities.

Moreover, during the second phase of reflection teachers were able to reflect on continuous activities which include projects and experiments, which contribute 25 percent of the final mark. Teachers' accounts indicate that continuous activities were taken from the CAPS document as prescribed whereas informal activities were from the various textbooks used by teachers. This suggests that CAPS does not give prescribed informal activities, meaning that a learner from school A could write a different activity on the same content than a learner from school B because of their type of textbook. This brings confusion to learners when they write examinations since they use different informal activities in preparation for the formal activities. Furthermore, this indicates that the success of activities depend on the teaching role that teachers perform during the implementation of this activities, which is evident when Khoza (2013a) concludes that a learning activity is about how the teaching is done by teachers offering a subject.

Furthermore, the findings during the implementation of the phase two lesson plan shows huge empowerment since teachers were aware of the issues of gender in the teaching of physical science CAPS. Thus, "curriculum change involves a rethinking of what we do" (Nieuwenhuis, 2011, p. 183). Learning analytics can assist teachers to understand learners' behaviour so that teachers will know which activities to administer in order to lead to the success of learners (Prinsloo & Slade, 2013). This suggests that teachers did activities based on gender. Teachers have reflected critically in this action research. Findings show that physical science curriculum is not entrenched in gender, but what matters most is the teachers' role.

4.2. 6 How do you perceive your role as a Physical Science CAPS teacher?

- ***Theme 6: Teaching role***

'*I explain what they are expected to know before I introduce the new chapter, I instruct learners to take out their books and notes exercise books. Finally, I make chalk board summery',* said A1, the others agreed with A1. '*I normally allow learners to sit in groups and ask them to construct their own ideas from a textbook while I also probe questions that drive the lessons on organic chemistry, I assist them in drawing structural formulas'*, said E5. Others agreed with these reflections. Furthermore, this may suggest that participants were aware of only teacher-centred (instructor) role and learner-centred approach (facilitator) because no one reflected on content approach (assessor) during the first stage of reflections.

On the other hand, during the second phase of action research all participants seem to understand their roles. For instance B2 said, '*when doing experiments to check factors (surface area) that affect the rate of reaction, I instruct them which apparatus to use like solid tablet and powdered tablet I also demonstrate to them, thereafter, I divide them in groups while I am facilitating the experiment*.' D4 added that, '*I treat both learners and subject equally such that when I am going to teach projectile motion in Grade 12, I first use*

Grade 11 basic content to set the test that will invoke concepts on laws on motion, that assist to check the level of understanding of learners before I start a new lesson '. All other participants agreed with reflections from B2 and D4, but F6 added that '*I alternatively act as an instructor and a facilitator when I am teaching electricity and magnetism'*. This suggests that during the second session all participants knew their role.

The above findings in the first phase of reflection indicate that, teachers were at the first and second level of reflection. As a result, their duties clarified themselves as teacher-centred (instructor) and learner-centred (facilitator). This suggests that they were acting as instructors as they gave firm instructions to be followed by their learners. At other times they acted as facilitators who asked their learners to search for information from their textbooks while they assisted learners to construct their own ideas. The findings indicated that teachers used a combined teacher-centred and leaner-centred approach to teaching and that it worked for them.

Furthermore, during the second phase teachers were transformed in such a way that they even reflected on the third level of reflection (content-centred approach) in which teachers used content to drive their lessons. Teachers' findings indicated that they were not aware of what drove their role as teachers of Grade 12 Physical Science CAPS. As a result, Khoza (2015a) concludes that if teachers use aims or objectives to propel their lessons, it implies that they are using the teacher-centred approach; if they use learning outcomes to propel their lessons it implies that they are using the learner-centred approach; and if they use content to propel their lessons it means that they are using the content-centred approach. This suggests that it is fundamental that teachers select an applicable approach to position their teaching roles. It is up to the teacher to use approaches alternatively as they have indicated from their reflections. Georgii-Hemming and Westvall (2010) reveal that teaching should not only be about knowledge transmission (performance curriculum), but should also be about learners actively constructing their own ideas (competence curriculum) through interaction between the teacher and the learner, learner and learner. Prinsloo, Muller and Du Plessis (2010) further affirm that curriculum instructional approaches have influence on the failure or success of students. This suggests that alterations of learner-centred and teacher-centred roles may assist teachers to complete their syllabus.

Furthermore, the teachers' accounts showed that they were not aware that CAPS is silent when it comes to their teaching roles. In other words, the intended curriculum (CAPS) does not allow teachers to make choices as to which approach teachers should use in order to implement their subject. Teachers' accounts indicate that teachers had to assume the teaching methods used when teaching. This suggests that physical science CAPS is not consistent with ensuring the proper implementation by teachers. Therefore, there are few chances that CAPS may be sustainable. In fact, the teachers' role alone will not prosper without resources that enhances the teaching of the physical science CAPS.

4.2. 7 What material are you using to teach Physical Science CAPS?

- ***Theme 7: Resources***

A1, D4 and F6 agreed with the statement made by C3, '*I use textbook (study and master), question bank for previous question papers and chalk board for writing summery'.* E5 said, *'I use [the] internet to download previous questions papers in PDF and MS word format and relevant textbooks from my cell phone and print them to make copies. On Saturdays, I invite learners to come and watch DVDs (PowerDVD) in different chapters for physical science CAPS using a computer'*. These reflections indicate that participants were only aware of hard-ware and soft-ware resources because none of them reflected on ideological-ware during the first phase of action research.

On the contrary, all participants showed an understanding of ideological-ware during the second phase because they all agreed with B2 who said, '*I always use outcomes to drive my lessons in physical science CAPS, when I asses my learners I use hierarchy of cognitive levels stipulated in [the] CAPS document (bloom's taxonomy) and I also use both teacher-centered and leaner centered approach alternatively in my teaching of physical science CAPS*'.

Teachers' accounts from the first phase of action research only reflected with the first level (hard-ware) and second level (soft-ware) of reflection and did not include the third level (ideological-ware) of reflection. Any person or thing that communicates teaching becomes a teaching resource and resources are therefore separated into hard-ware, soft-ware and ideological-ware resources (Khoza, 2012). The teachers indicated that, in most cases, they were using textbooks and notes books (hard-ware) to teach physical science CAPS and sometimes used computers for learners to watch DVDs using the PowerDVD application (soft-ware). Nakpodia (2013) and Meier (1995) believe that school principals should provide hard-ware and soft-ware resources for teachers in order to ensure the successful implementation of the curriculum. This suggests that the provision of relevant resources like Audio-visual (textbook, television, etc.), Visual (mobile pictures) and auditory materials (listening activities) may catalyse the teaching of the physical science CAPS. Furthermore, teachers' accounts showed that they were not aware that they themselves were also teaching resources. Kehdinga (2014b) believes that teachers are one of the most important resources during the curriculum implementation. This suggests that the teaching methods (ideological-ware) that a teacher chooses, influences the teaching practice of physical science CAPS.

In addition to the above, the teachers' accounts showed that they were aware of the key resources (ideological-ware) during the second phase of reflection (phase two lesson plan) because there were able to reflect on whether they used teacher-centered or leaner-centered approach in their teaching. Understanding if the curriculum is propelled by teacher-centred, learner-centred or content-centred approaches enhances the likelihood of achieving the intended curriculum (Khoza 2013b; Hoadley and Jansen 2013).Thus; teachers are not limited to these kinds of teaching theories in teaching the physical science content. First of all, teachers should understand ideological-ware resources that underpin their intended curriculum (CAPS) before the teaching processes begin in order to ensure the positively achieved curriculum. Therefore, teachers are allowed to use the thousand theories they know during their teaching practice (Kehdinga, 2014a). This suggest that teachers, in their teaching practice, may use a combination of Tyler's (1959) objective/product approach for the presentation of a lesson and use Stenhouse' (1975) process approach for learning activities as well as Freire's (1985) critical approach in analysing learners attained results in order to have a balanced teaching process.

Furthermore, from the findings, it is clear that there is no specific theory, indicated by the physical science CAPS, to be used by teachers in their teaching process. As a result, Kehdinga (2014a) believes that the curriculum should be open to anyone in order to accommodate the hundred thousand theories which have to do with teacher's personal, social and political dimensions of the intended curriculum. This suggest that teachers can use all kinds of available resources to improve the teaching of physical science CAPS. However the teachers' findings indicate a scarcity of resources in their schools which makes it impossible to implement experiments. Berkvens et al. (2014) indicate that digital resources like the internet might solve the problem of scarce resources in schools. This suggest that schools should have internet connection, but it is impossible to have internet in rural schools that have no electricity, which makes it hard for teachers to use digital resources in the teaching of physical science CAPS. In fact, if resources could be used at the right time, within a conducive location, the physical science CAPS may be smoothly implemented by teachers.

In addition to the above, urban-rural differences still play a major role in the teaching of the curriculum (NEPI, 1993), which suggests that those teaching physical science in rural areas still suffer from the lack of resources caused by extreme poverty which in turn effects the teaching of physical science CAPS. As a result of the shortage of books and the fact that classrooms are limited, coupled with the fact that schools have no computers, let alone access to the Internet, teaching of Physical science CAPS is disrupted in rural areas. Furthermore, NEPI (1993) reports that 70% of black learners receive their education from homelands like farm and rural areas. This suggests that, by virtue of race, rural areas are mostly taught by black teachers and they are supposed to improvise in cases where resources are scarce. However the findings from teachers indicate that teachers are able to improvise and use what they have in order to teach a fellow black South African. This suggests that South African education needs to be transformed in order to improve the educational experiences in rural schools, but transformation begins with teachers who implement the curriculum. Hence, the teachers' findings show a huge improvement during the action research, but without well-resourced schools (locations) with enough time for teaching physical science content, the teaching will not sustain for quality assurance purposes (Berkvens et al., 2014).

4.2. 8 Where and when are you teaching Physical science CAPS?

- ***Theme 8: Location and time***

'I teach during the week days and on Saturdays using the classroom without electricity', said A*1 'I use five periods per week which is one hour each to teach physical science content, also*

use morning and afternoon classes to teach learners in a classroom', said C3. Furthermore, B2 said, '*I teach four hours per week including one extra hour during afternoon every week and I struggle to teach experiments since there is no electricity and there is no laboratory to do experiment at my school.*' All participants agreed with these reflections in the first phase of action research during reflective activity, semi-structured interviews, and grouped discussion processes. Seemingly, participants were not aware of the time allocation as stipulated from CAPS document.

In addition, E5 pointed out that, '*Internet space and time is useful to the teaching of physical science CAPS but, unfortunately in my rural school there is no internet connection which is the drawback in my teaching'.* All other participants agreed with E5. '*I teach Physical science CAPS content wants for 6 hours per cycle of 12 days but this time is not enough. As result, I create my own time during weekends to meet with learners'*, said D4. All other participant's reflections were in line with that of D4 during the second phase of action research.

On one hand, from the first and the second phase, teachers indicate that they do not read the CAPS document in order to find out the notional time for teaching physical science. This is because teachers' findings indicated that they taught 5 hours per week and some said they taught 6 hours per cycle. On the other hand, "the teaching time for physical sciences is 4 hours per weeks in total per grade, with 40 weeks" (CAPS, 2011, p. 9). Based on the research findings, teachers use different times and venues to teach the same content as prescribed by the CAPS document. Findings indicated that some venues (classroom) are not conducive for teaching physical science CAPS as there is no electricity, and that alone makes the teaching of physical science complicated because teachers could not use internet resources to teach their learners. Khoza (2015b) believes that one has to utilise internet resources which can connect one to all the corners of the world and bring education to learners' living venues. This suggests that hard-ware, soft-ware and ideological-ware resources, are supposed to be used to help learners in the teaching of physical science CAPS in different venues at a specific time allocated. According to Khoza (2011) this serves as a good practice for teachers to use resources in a balance way.

Furthermore, the findings indicate that the allocated contact time is not enough to complete the prescribed content, and that teachers are forced to organise extra hours for extra-classes in an unfavourable environment in order to complete the physical science syllabus. At the same time, teachers are not paid for these extra hours and end up demotivated because there are no incentives for extra-classes. In this regard, teachers cannot ensure high quality in the teaching of CAPS, since they find it hard to practically teach physical science CAPS without appropriate locations and sufficient time (Berkvens et al., 2014). Coetzee (2009) also believes that the effective teaching of the physical science curriculum may be facilitated by organising the physical location of the classroom (via organising furniture) in order to encourage proper teaching. Simond, Du Preez, and Roux (2012) further affirm that South African classrooms have major challenges but it must be organised in such a way that it informs learners' human rights. The availability of school furniture influences conducive teaching of a subject. This suggests that without a conducive learning environment, assessment will not be done properly in order to attain learning outcomes. Further to this, it suggests that teachers should support the inclusion of human rights in the physical science curriculum in order to enhance good assessment of learners.

4.2. 9 How are you assessing learners in Physical science CAPS?

- ***Theme 9: Assessment***

In the first phase, all participants reflected on informal and formal assessment which is category one and two level reflections. '*I asses learners through group works, class works, short class test and home works, I do not record this work'*, said F6. A1 added that, '*I give learners informal assessment task like class work and formal task like control test in order to asses my learners'. All participants agreed with A1 and F6.* None of the participants reflected on continuous assessments during the first phase. However during the second phase B2 said '*I use solutions for all to extract class works and home works to asses my learners, I depend upon CAPS document to do formal task like control test from the Department, I also expose my learners to continuous task (CASS) like experiments* 'In terms of assessment, during the first phase of reflection all teachers indicated that they follow their CAPS document which stipulates the use of both informal (formative) and formal (summative) assessments (Khoza 2015a). During assessment of learners for attained learning outcomes, formative and summative assessments are useful. That is why teachers first reflected on formative assessment. Formative assessment is taken as a part of teaching when learners are assessed for their understanding of concepts. This suggests that teachers must provide support if necessary without first grading learners as formative assessment often takes place during the learning processes. Secondly, teachers reflected on summative assessment, which is an assessment of learning taken through a summary of formative assessment of their learners' attainments of learning outcomes. During summative assessments, teachers grade their learners, often at the end of the teaching processes.

In addition to the above, teachers' indicated that they give learners class and home work without any intention of recording their work for grading purposes. It is for this reason that formative assessment needs to be undertaken in order to develop learners during the teaching process (Hoadley & Jansen, 2013). This suggests that teachers ensure weekly tests, class work and homework assignments be aimed at providing special help to learners that are struggling with the physical science CAPS. Formative assessment engages teachers in a conversation with learners which allows the assessment to be part and parcel of the teaching and learning process. It also generates a lot of feedback from the teacher to the learners (Khoza, 2015a).

Furthermore, findings showed that summative assessment is the key assessment in CAPS. As a result, teachers gave learners controlled tests which form part of the summative assessment process to grade learners. Teachers used summative assessment, like examinations, in order to summarise the student learning outcomes (Kennedy et al., 2006). This suggests that, it is necessary for physical science curriculum teachers to use summative assessment in order to issue learners' report to parents. Research findings indicated that teachers were following the CAPS document in order to assess learners. However, Berkvens et al. (2014) concludes that assessment and learning outcomes play a major role in measuring the quality of any curriculum. Assessment depends on the intended curriculum and implemented curriculum for the positively achieved curriculum. As a result, the study indicates that what should and should not be assessed depends on the intended curriculum (Hoadley & Jansen, 2013). This suggests that teachers' assessments should depend on learning outcomes as stated by the physical science CAPS. However, the CAPS document does not specify any learning outcomes and that can confuse teachers. On the contrary, CAPS does specify all the summative tasks to be conducted each term which is why teachers find it easy to do continuous assessment (CASS).

In the second research phase, teachers even reflected through the third level of reflection (critical level) on continuous assessment (CASS). CASS is often taken as a repetition of summative assessments with marks being recorded but little or no specific feedback given to the learners (Kennedy et al., 2006). It is for this reason that teachers gave experiments to learners since experiments took place over a long period of time and contributed to a certain percentage of the grade at the end of each year. This suggests that if teachers miss performing this kind of assessment, it would contribute to the failure rate of learners doing physical science CAPS. CAPS (2011) is clear about assessments. The programme of assessment is designed to indicate the type of assessment and the levels of grading, thus the assessment in CAPS is relevant, consistent, and suitable for quality assurance purposes. As a result, experiments (CASS) contribute 45 marks. March, June and trial examinations (CASS) contribute 65 marks. This makes a total of 100 marks of CASS. Final examination is made of paper1 and paper 2 which makes a total mark of 300, the final total (CASS + final examination) makes up 400 marks. This suggests that the contribution of CASS makes it easy for learners to pass but the problem lies with final examinations (achieved curriculum). In conclusion, Combrinck (2003) asserts that assessment must be authentic because it prepares learners for life after school.

4. 3 Concluding statement

Chapter Four has determined the data presentation, analysis and discussion. This chapter began with a table showing all the themes taken from the curricular spider-web; the levels of reflections (technical, practical and critical level); and the categories that emerged from these themes. The data generated was discussed and analysed following the themes and categories per level. Data from all stages of this action research showed the association across all themes. The development of lesson plans from the first to the second phase indicated transformation based on themes which include: rationale, content, goals, activities, teacher role, location and time, resources, accessibility and assessment. The findings also outlined that the teaching of physical science curriculum reflects the performance curriculum as opposed to the competence curriculum. The next chapter will outline the summary of the study, the main conclusions and the recommendations.

CHAPTER 5

Summary, conclusions and recommendations

5. 1 Introduction

The study set out to explore teachers' reflections on the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools, including some matters related to the curriculum. The study has also sought to understand teachers' reflections; explain what informs those teachers' reflections; and also understand the lessons that could be learnt by teachers, specifically those teaching the physical science curriculum (CAPS) in rural schools. Furthermore, the study sought to answer three research questions: what are the teachers' reflections; why do teachers reflect in particular way; and what lessons can be learned from the teachers' reflections on teaching the Grade 12 Physical Science. The previous chapter has presented, analysed and discussed the data generated. As a result, this chapter intends to present the summary, main conclusions and recommendations derived from the data analysis and discussions. Based on themes emerging from the data discussed in the previous chapter and the conclusions of this study, noteworthy recommendations will be made.

Furthermore, this chapter begins with a summary of each of the previous chapters (5.2 Summary of chapters). Section 5.3 discusses major findings of my study, followed by suggestion for further research in section 5.4. Section 5.5 states the recommendations made by this study. Section 5.6 outlines the concluding statement of Chapter Five.

5. 2 Summary of chapters

This study focused at exploring teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools. Furthermore, the study tried to understand the nature of these reflections, what informed these reflections and what can we learn from them in order to improve the practice of teaching physical science. As a result, the study has covered the chapters from one up to four. Table 5.1 below indicates the number of words in each chapter, from Chapter One up to Chapter Four.

Chapters	**Numbers of words**
Chapter 1 (The overview, context and background)	7522
Chapter 2 (Literature review)	20553
Chapter 3 (Research design and methodology)	9271
Chapter 4 (Research findings)	11413

Table 5.1: Chapters versus number of words

Furthermore, Figure 5.1 clearly indicates the percentage of words in each chapter. This suggests that Chapter Two retains a lions' share of this study, since it occupies 42% of the study followed by research findings and discussions which retain 23% of the study. As a result, these two chapters will be compared in drawing conclusions, summery and recommendations of the study.

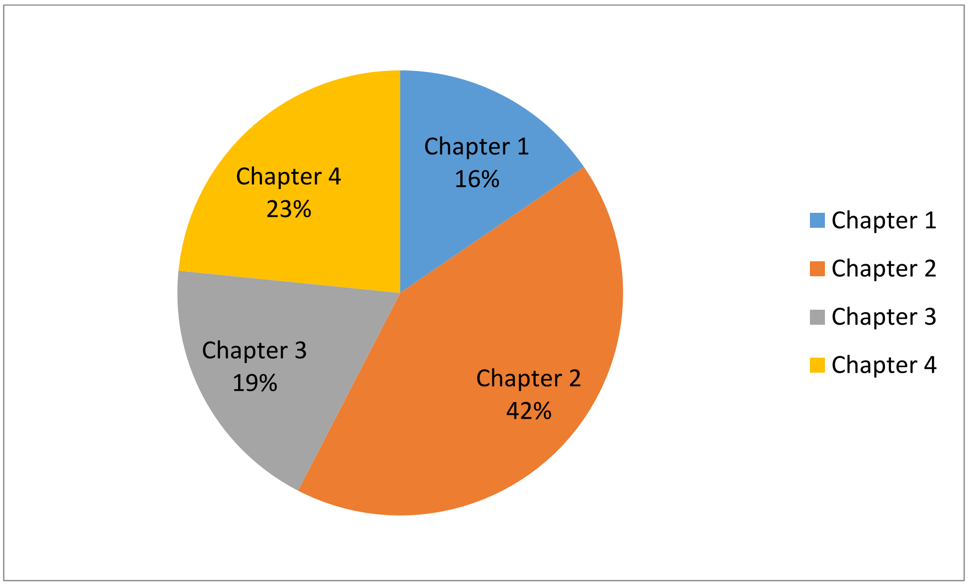

Figure 5.1: Percentage per chapter.

5. 2.1 Chapter One

The first chapter provided the general background of the proposed study. Chapter One outlined the title (Teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools) of the study (section 1.2) after an introduction in 1.1. I stated the focus of the study in section 1.3, the exploration of teachers' reflections on the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools. I also mentioned the location of the study, specifically six rural high schools offering physical sciences curriculum in Ceza Ward, under the Mahlabathini Circuit, within the Zululand district of KwaZulu-Natal (delimitation). The rationale of the study in section 1.5 indicated my personal reasons for undertaking the study, and what the literature states about the study phenomenon (teachers' reflections) and study focus (teaching of physical science). The rationale also looked at how useful this action research will be in the field of education. Furthermore, section 1.6 looked at the literature review where the 10 concepts of curriculum spider-web were outlined (Van den Akker et al., 2009).

The study objectives were outlined in section 1.7 as:

A. Understanding teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools.
B. Explain what informs teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools.
C. Explain the lessons that can be learnt from teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools.

Followed by research questions:

A. What are the teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools?
B. Why do teachers reflect in particular ways of their teaching Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools?
C. What lessons can be learned from the teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools?

I indicated the research design and methodology (section 1.9 to 1.14) by outlining the research paradigm (critical paradigm), research style (action research), sampling (convenience and purposive), research methods (reflective activity semi-structured interview and focus group discussion), data analysis, limitations, ethical clearance issues and trustworthiness issues**.**

5. 2.2 Chapter Two

This chapter reviewed the literature of the five areas related to the study: teacher's reflections; curriculum presentation (intended curriculum, implemented curriculum and achieved curriculum); competence curriculum versus performance curriculum; curricular spider-web concepts (conceptual framework). The chapter first looked at teachers' reflections through three levels: technical level of reflection, practical level of reflection and critical level of reflections (van Manen, 1977). These levels indicate that all teachers' reflections were categorised according to these levels in the findings and discussion chapter. Chapter Two defined and presented the curriculum and established that the curricular spider-web is utilised in this action research as the conceptual framework. The chapter indicated that the curricular spider-web was composed of ten concepts that were used to organise the literature reviewed. These concepts are: the rationale, the aims, the content, teachers' roles, teaching activities, resources, accessibility, location, time and assessment (Van den Akker et al., 2009). There is a summary of all concepts with propositions, authors and gaps in Table 2.1. The literature outlined that for the effective teaching of any subject (implemented curriculum) these concepts must be prioritised with equal weight. If they are not considered equal by implementers, then the intended curriculum may not be able to attain its objectives or sustain an acceptable quality of education (Berkvens et al., 2014).

5. 2.3 Chapter Three

Chapter Three provided details of the methodology adopted by this study. The study adopted the qualitative research design approach which is located within the critical paradigm. As a result, the study aimed not just to describe and understand the phenomenon, but also to enhance justice and fairness in society as a whole (Cohen et al., 2000). This chapter outlined six teachers who were involved in an action research process which required them to plan, implement, observe and reflect on their behaviour in order to improve their practices. The study used a teacher reflective activity, one-on-one semi-structured interviews and a focus group discussion for data generation. This chapter also described sampling which includes convenience sampling, and purposive sampling (Cohen et al., 2011).

In addition, this chapter paid particular attention to the following dimensions in order to increase trustworthiness of this study: credibility, transferability, dependability and conformability. This chapter also adopted guided analysis which included both inductive and deductive reasoning as a process. Ethical issues in this chapter were detailed in such a way that all ethical principles were considered (which includes seeking permission to conduct the study from the University (UKZN), Department of Basic Education, school principals, participants and the circuit manager). Informed consent letters also stipulated issues of ethical principles which included autonomy, non-maleficence and beneficence. In addition, this chapter also articulated issues relating to possible problems (limitations) met during the course of the study. This chapter indicated how the issues of biases and generalisation were addressed.

5. 2.4 Chapter Four

This chapter presented, analysed and discussed the findings from teachers' accounts. This was done via guided analysis following the ten concepts of the curricular spider-web. These concepts developed themes which then formed categories that were aligned with the relevant level of reflections, (Table 4.1). The categories were discussed in order to explore teachers' reflections on the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools so that teachers could improve, change or transform their teaching practice.

5. 3 Major findings

The conclusions are taken from the findings (data analysis and literature) of the study and will be discussed following the concepts of the curricular spider-web as the themes that organised teachers' reflections of the teaching of Grade 12 Physical Sciences CAPS. The curricular spider-web concepts are seen to take a leading role when comparing findings from the literature review, CAPS and data analysis in this study. Both Table 5.2 and Figure 5.2 below compare each concepts of curriculum spider-web from the literature review findings and data analysis findings. Rationale is described as a response to the question of why a subject is taught in schools (Van den Akker et al., 2009). As a result, there is a greater number of words from data analysed than literature reviewed. The concepts of accessibility in the teaching of the physical science subject includes issues of physical access (is it possible to reach school), the financial access (is the education affordable) and cultural access (is the programme socially acceptable) as asserted by Berkvens et al., (2014). As a result, data in the literature review is higher than data in the data analysis in Chapter Four. This means that little has been found from participants as far as the concept of accessibility is concerned.

Furthermore, elements such as aims, objectives and learning outcomes (Table 5.2 and Figure 5.2) play a major role in this study since they have a greater number of words than any other concepts which means that goals are at a pick of the graph. Learning outcomes had more contribution than any other propositions. Thus, goals weigh much more in data analysis than in the literature review. This suggests that teachers eluded more on goals in data analysis than the literature reviewed. As a result, without goals especially learning outcomes, intended aims and objectives of curriculum will not be achieved (Khoza, 2013a).

In addition to the above, the data analysis (Figures 4.3 and 4.4) indicates that the second concept considered most when teaching is the rationale. Conversely, the second largest priority established by the literature review was the content. This suggests that after goals, the rationale and content play a significant role in the teaching/implementation of physical science as a subject. Findings from data analysis indicate that teachers' rationale was based more on personal and societal rationale than content. This is in line with what the literature argued when it stated that teachers taught because they have passion and want to contribute to the development of learners (Khoza, 2015a). Findings from the literature show that, a good and relevant subject topic makes up a good content for the intended curriculum (Shulman, 1987). The findings from data analysis indicated that teachers reflected more on subject topics than other prepositions like experiments and subject/content knowledge. This is because the teachers' reflections occurred mostly on one level, namely the technical level.

Furthermore, anything or person that facilitates or communicates learning in physical science is called a resource (Khoza, 2012). Thus, findings on resources from data analysis and literature are equal in term of the percentage, see figure 4.3 and 4.4. This concept contributes 11%. The literature argued that ideological-ware is of paramount importance as compared to soft-ware and hard-ware resources. On the other hand, teachers technically reflected on hard-ware. This indicates the gap in the teaching practice by teachers. Further to this, assessment in the literature review is 12%, but from findings is 8%. Summative assessment contributed much in the literature as compared to formative and continuous assessment. Most teachers reflected on summative assessment in data analysis. Assessment is taken as critical concepts because it deals with the measurements of learning (Hoadley & Jansen, 2013).

The comparisons from Figure 5.2 and Figure 4.4 indicate findings from data analysis about accessibility, teaching activities, teaching roles, location and time concepts. These concepts generated fewer findings. This suggests that these concepts contribute less towards the teaching/implementation of the physical science curriculum. As a result, one can suggest that there are minor concepts of the curriculum spider-web, namely: Time, Activities, Location, Assessment and Roles. In this order they form the TALAR acronym. On the other hand, one can assume that there are five main/major concepts of curriculum spider which are Content, Rationale, Accessibility, Resource and Goals (CRARG).As a result one can conclude that, through teaching, the curriculum spider-web concepts are not equal and instead consist of major, CRARG, and minor, TALAR, components.

Concepts	**Number of words**	
	Data analysis	**Literature review**
Rationale	1834	1362
Accessibility	1040	1201
Goals	1908	1797
Content	1058	1456
Teaching activities	703	1155
Teaching role	693	1309
Resources	1023	1271
Location and time	633	907
Assessment	814	1363

Table 5.2: Comparison of Data analysis and Literature review number of words

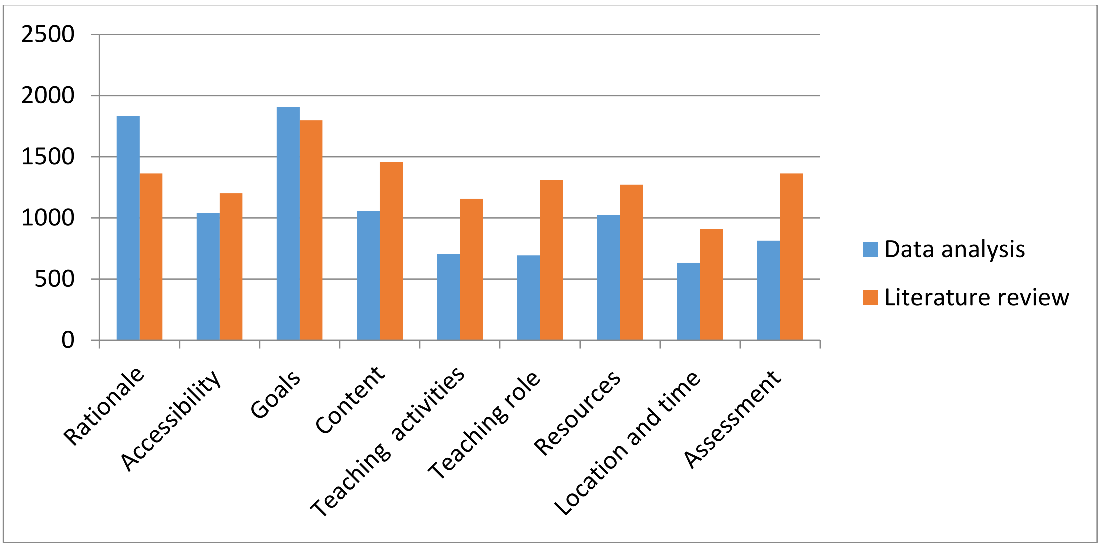

Figure 5.2: Comparison of Literature review and Data analysis findings.

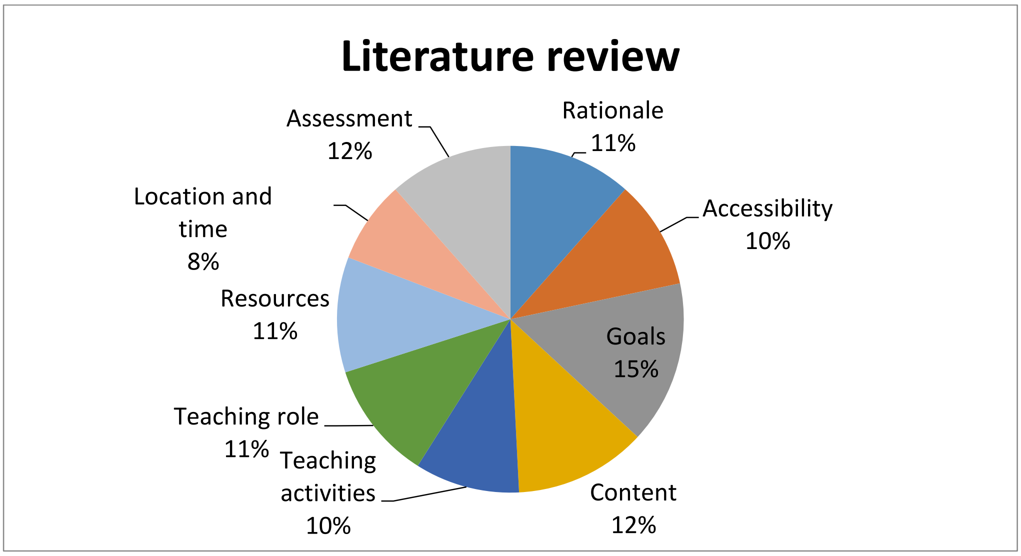

Figure 5.3: Curricular spider-web concepts in percentage from the literature review

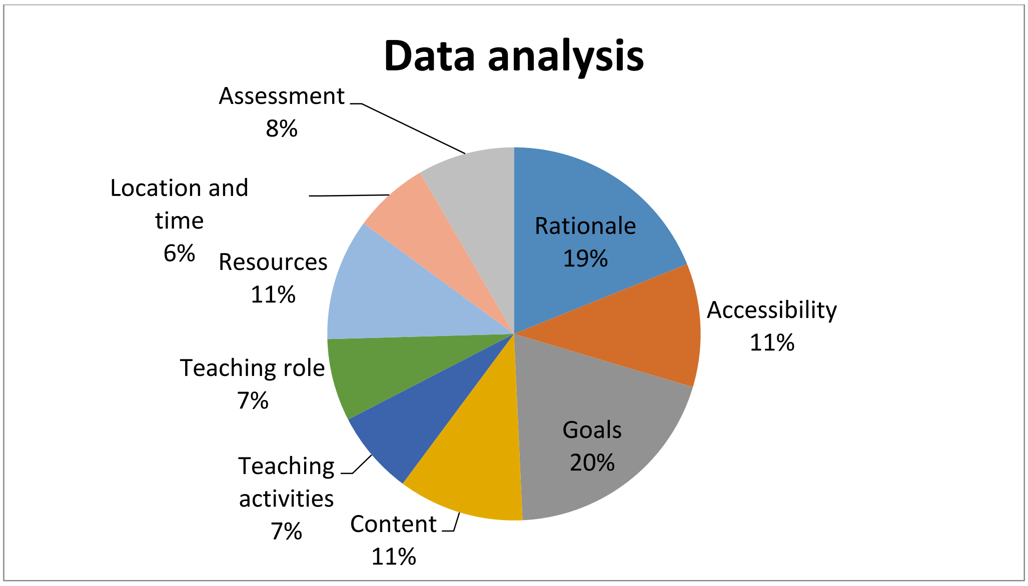

Figure 5.4: Curricular spider-web concepts in percentage from Data analysis.

5.3. 1 Rationale

According to the studies from the reviewed literature, the rationale of teaching any subject may be based on pedagogical/personal rationale, societal/social rationale, and content knowledge rationale (Berkevens et al., 2014). The personal rationale becomes the first rationale for teachers teaching physical science curriculum. Teachers' personal rationale assist learners to attain the achieved curriculum and it helps teachers to theorise on any curriculum (Kehdinga, 2014a). This suggests that personal rationale comes first followed by societal/social rationale in the teaching of physical science curriculum. Schon (1995), Kehdinga (2014a) and Khoza (2015a) believe that society should enlarge the professional behaviour that will promote professional effectiveness in the implementation of curriculum. This clearly shows the importance of society in the rationale behind teaching the physical science curriculum. Furthermore, qualifications also play a major role in the rationale for teaching the curriculum. This is in line with what Khoza (2015) outlines, when he said that some participants taught their subject content based on what the CAPS documents stated. Thus, for teachers to understand and teach CAPS content they need to be qualified (content knowledge rationale).

In addition to the above, a good and valid rationale behind teaching can enhance the correct implementation of Grade 12 Physical Sciences CAPS (Khoza, 2015b). However, CAPS (2011) does not specifically state any rationale as to why teachers teach the physical science curriculum. This suggests that CAPS has a drawback when it comes to the rationale for teaching. Thus, teachers have to think for themselves as to why they are teaching. Teaching without a rationale may yield poor performance of the curriculum. Furthermore, Teachers do not have any idea as to where to indicate the reasons for teaching Physical Science CAPS during lesson planning. Rationale for teaching may enhance proper implementation of the curriculum. It is not clear from the Physical Science CAPS document where exactly teachers may indicate the reasons for teaching the physical curriculum. CAPS is a performance-based curriculum which supports school knowledge (Hoadley & Jansen, 2013).

Furthermore, the findings from the data analysis indicated that there is a need for a strong rationale as it becomes the pillar through which all the other concepts of the curricular spider-web are supported and will enhance the teaching of the Physical Science CAPS. Data findings indicate that a strong rationale (personal, societal and content rationale) may act as a catalyst in the teaching of physical science in order for teachers to improve their teaching practices. The teachers' accounts indicate that both personal and societal rationale come before any other rationale in their teaching of physical science. This is because these rationales are based on general knowledge (not on research). The content rationale comes after critical reflections and it is based on school knowledge (based on research). This suggests that teachers' reflect first from a technical and practical level and this provides answers to the first question: What are teachers' reflections? Furthermore, findings from the data also answered the second research question when it was found that teachers still use everyday knowledge, rather than school knowledge, when reasoning during the teaching of physical science. As result this may have a negative impact on the achieved curriculum. However, data findings indicate that when intervention programmes are administered, teachers start to transform and change in order to critically reflect on the teaching of Physical Science CAPS.

5.3. 2 Accessibility

According to the literature reviewed, accessibility towards the teaching of Physical Science CAPS is based on three proposed accesses: physical access (technical level of reflection); financial access (practical level of reflection) and cultural access (critical level of reflection) (Berkvens et al., 2014). According to the literature, cultural access (gender, race, religion, etc.) to education appears to play a major role towards the teaching of Physical Science CAPS. Dlodlo (2010) indicates that cultural access includes the issue of socio-economic factors on girls and women's access to education and training in rural South African schools. This suggests that from the critical level of reflection cultural access may be taken into consideration, but physical access is taken as the first form of accessibility that influences the positively achieved curriculum.

However, the CAPS document is silent when addressing the issue of accessibility in the teaching of Physical Science CAPS. In other words, CAPS does not address what mode of transport (physical access) teachers should use and how much teachers should pay to access the schools. Easy physical access in schools may enhance smooth implementation of the curriculum. Furthermore, CAPS does not address the issue of cultural access. As a result, CAPS may not be sustainable and there will be little consistency in the teaching of Physical Science CAPS (Berkvens et al., 2014).

The findings from the data highlighted the importance of physical access (technical reflection). In some cases, teachers had to walk to school as they struggle with access to finances (practical reflection) for transport since they are underpaid. The findings showed that the Department does not provide teachers with transport, especially those staying far from school. The department has to provide the transport to support the implementation of intended curriculum and this may yield better pass percentage.

According to the findings, teachers were transformed during the course of this research which answers the third research question as to what is learned from teachers' reflections. The teachers' transformation indicated that there were able to reflect critically. Teachers indicated that girl learners as compared to boy learners, at times miss attending extra classes because of cultural function in their homes and community. The third level of reflection (cultural access) is as a result of the community in which the school is located. There was no race, religion, or linguistic difference in the schools studied but there was a high degree of absenteeism at school due to cultural activities conducted at learners' homes. Cultural activities like ritual functions in learners home. This impacted negatively on the consistent teaching of the physical science curriculum. The findings indicated that the language of teaching and learning (English) became a barrier in teaching of Physical Science CAPS. Findings indicated that learners who speak English as a second language find it too difficult to learn and communicate in English.

5.3. 3 Goals

During the evaluation of goals, it was clear from the research findings, especially during the first phase of the study, that teachers' only reflected (aims, objectives and learning outcomes) on a technical level (aims) and practical level (objectives). Teachers only used aims and objectives during their teaching practices, and they didn't differentiate between the aims and objectives. Furthermore, it is found that they used lesson plans that do not establish goals and would instead refer to aims and objectives from the CAPS document. The teachers' accounts clearly indicated that their learning outcomes occurred last in their teaching practice. After the various stages of this action research, teachers were empowered and transformed in such a way that new lesson plans addressing goals were implemented with an improved understanding of their teaching purpose. The teachers' new understanding of goals may reduce the gap between intend and implemented curriculum.

In addition to the above, the literature also concurs with the research findings in asserting that aims and objectives give the direction of implemented curriculum. Khoza (2013a) believes that the aims and objectives provide clear guidance in achieving the intended learning outcomes. If teachers are confused between aims and objectives, it may become too difficult for teachers to master the learning outcomes. Furthermore, Percy (2005) believes that teachers should reflect critically so that they are able to contribute towards transformation in the teaching of physical science. In other words, through critical reflection teachers may consider using learning outcomes in order to improve their teaching of the Physical Science CAPS. While the literature indicates that learning outcomes are not included in curricular spider-web concepts, they remain vital in measuring students' performance and evaluating whether or not the curriculum goals were attained. As a result, even if learning outcomes do not form part of the spiders-web, it is crucial for teachers to know the basics of blooms' (1971)taxonomy in order to use action verbs in the formulation of learning outcomes (Khoza, 2014b). This suggests that learning outcomes are of significant importance in improving the teaching practice of the physical science curriculum. Furthermore, the literature indicates that learning outcomes are learners' intention in order to fit the intended curriculum (Khoza, 2014a & Berkvens et al., 2014).

In light of the above, the CAPS document, as a performance-based intended curriculum, does not specify aims and objectives per subject (Khoza, 2014b). This suggests that CAPS only specifies intended curriculum aims rather than content or subject specific aims. This concurs with what the findings assert in this study. The CAPS document indicates the general aims for all subjects from Grade R–12. According to Khoza (2014b) general aims that fit all grades confuses teachers. Furthermore, what learners should learn depends on aims and objectives. Aims and objectives display the society (society values), subject (curriculum reflection) and student (creating opportunities) (Berkvens et al., 2014). Thus, the CAPS document's general aims and objectives are relevant since they do address the issue of society, subject and student. Practically, aims and objectives may not be applied if they are not specific to content stated from CAPS document. As a result, CAPS may not be sustainable in future because there are no stated learning outcomes such as intended, implemented and attained learning outcomes. Without observable learning outcomes, teaching and learning will not be successful (Khoza, 2013a). In other words, there is no consistency of learning since the Physical Science CAPS document does not align objectives to learning outcomes.

5.3. 4 Content

The literature outlines that for any teacher to teach Physical Science CAPS, content should be well versed with three key propositions: subject topics to be covered; experiment/practical work; and subject knowledge. Teaching starts with the teacher's understanding of the subject topics that are taught (Hoadley & Jansen, 2013). The literature suggests that the technical level of reflection begins when a teacher knows which content to teach, followed by knowing which practical work/experiment (practical level of reflection) is to be done with learner. Above it all, it is vital that a teacher does possess the content knowledge of a subject because the teaching becomes easily understood by learners. This is influenced by the critical level of reflection which enhances transformation in the teaching of physical science (Percy, 2005). Content knowledge entails knowledge of the subject and its structures (Shulman, 1987). This suggests that in order to possess content knowledge, one need to be qualified and trained to teach a particular subject. As a result, qualified teachers possess content knowledge of a subject because they were trained to teach science. This makes it easy to teach Physical Science CAPS.

Physical Science CAPS includes sequential topics organised per term and it prepares learners for local life and future education in the international world (Berkvens et al., 2014). This clearly indicates that CAPS is a performance based curriculum and encourages school knowledge during the teaching process. As a result, CAPS will sustain in order to ensure quality in the implementation of the curriculum. CAPS do not equip learners with practical skills, especially in rural schools, since more time is given to theory than to experiments. The use of equipment is stated in the CAPS documents but it cannot apply to the local school context in rural areas where there is no electricity or laboratories. As a result, according to Berkvens et al. (2014) there is no consistency in the teaching of the physical science curriculum.

In relation to the findings from the data analysis, six teachers of different schools teaching physical science in rural schools find it simple to teach physical sciences. This is because subject topics are divided into paper 1 and paper 2. Data findings indicated that topics are arranged to be taught per term. This is in line with what is found from the literature and CAPS document. It is found that organised topics relate to performance curriculum. Furthermore, data findings indicate that some teachers are good in paper 1 and some are good in paper 2. This may dent the proper teaching of Physical Science CAPS. In addition, teachers indicated that they attempt to conduct experiments as stipulated by the CAPS documents but that there is not enough equipment in schools to carry out such experiments. Often they are unable to conduct experiments since there are no laboratories and science resources in rural schools. In addition to that, findings indicate that teachers are qualified. As a result they do possess the content knowledge of a subject since they are trained. Thus, they find it easy to teach learners the relevant content.

5.3. 5 Teaching activities

The most recommended teaching activities, according to the literature, are continuous activities which constitute 25% of the overall Physical Science CAPS mark. Continuous activities take place at interval periods of time (Hoadley & Jansen 2013). The literature revealed that activities should be linked to the real world environment (Khoza, 2013a). As a result, formal and informal activities play different roles in linking learners to the real word. The literature indicates that informal activities are conducted by teachers for non-grading purposes, whereas formal activities are conducted for grading purposes (Hoadley & Jansen, 2013).

Furthermore, the Curriculum News (2010) and CAPS (2011) concur with the literature which stipulates that there are two continuous activities to be conducted per term in the teaching of the physical science curriculum. The CAPS documents indicate a number of control tests to be done each term as part of the formal activities which are administered by teachers during the teaching process.

The findings from the data indicate that teachers reflected most at a technical and practical level in that they only provided details on informal and formal activities. Teachers forgot about continuous (CASS) activities (critical level of reflection) until the second phase of the study was administered. As a result, teachers managed to transform and master CASS activities as stipulate in the CAPS document and the literature reviewed. Furthermore, teachers indicated that they used various textbooks for various informal activities. It is clear from the findings that CAPS does not provide samples, per content topic for either informal or informal activities. Hence, this may contribute to the high learner failure rate.

5.3. 6 Teaching role

The literature proposes there are three roles of a teacher during the teaching process. A teacher can act as instructor (teacher-centred) at a technical level of reflection; facilitator (learner-centred) at a practical level of reflection; and assessor (content-centred) at the critical level of reflection (Khoza, 2015a; Hoadley & Jansen, 2013; and Percy, 2005). The literature indicates that the teacher's role is determined by the curriculum approach that the teacher adopts during the teaching practice. However, the literature indicates that in most cases teachers adopt roles as instructors and facilitators. In light of this, it is important for a teacher to choose an appropriate approach that will suit his role (Khoza, 2015a). Furthermore, findings from the literature indicate that the intended curriculum may influence the teachers' role. Pinnar (2004) believes that every teacher has a unique *currere* (autobiographical journey) during their reflection on teaching. As a result, a teacher can transmit information to learners (performance curriculum); involve learners in a teaching process (competence curriculum); and assess learners during the lesson. Thus, a teacher can use these three methods to finish the syllabus (Khoza, 2015a).

On the other hand, the CAPS document does not specify the teachers' role or the methods (teacher-centred, learner-centred and content-centred) that teachers should use when teaching the physical sciences. Teachers adopt any method they are comfortable with or that seems to work in a particular context. CAPS can therefore not bring consistency if the teachers' roles are not specified. In this respect, CAPS may not sustain for quality assurance sake (Berkvens et al., 2014).

In relation to the research findings, while CAPS does not specify any teaching roles, teachers know their roles. Hence, teachers were aware that at times they must act as instructors during the introduction of a lesson, and also act as facilitators during lesson presentation (for example by dividing learners into groups for discussions).The findings from the data suggest that teachers combined the two roles in one lesson which made it easier for them to teach physical science. After the action research stages, the six teachers realised that you must also teach as you assess (assessor). As result, their new proposed lesson plans included the critical role of the assessor. The findings indicate that the teacher plays a central role in all aspects of the curriculum as they revolve around understanding and applying concepts which includes, amongst others, planning, time, resources, learner activities, content and assessment.

5.3. 7 Resources

According to the findings from the literature, the most frequently used resources at both technical and practical level are soft-ware and hard-ware resources (Khoza, 2012 & Percy, 2005). The teachers' performance depends on available resources which would then influence their attainment of curriculum. Thus, it is the duty of a principal to avail resources that can be used to boost the teaching of the Physical Science CAPS (Nakpodia, 2013 & Meier, 1995).

On a critical level, the literature claims that without ideological-ware resources, hard-ware and soft-ware resources would be meaningless in the implementation of the curriculum. Khoza (2015a) and Kehdinga (2014a) assert teachers are not aware of ideological-ware (teaching methods) resource and are only aware of the hard-ware and soft-ware resources provided in schools. It is clear then that the lack of resources in schools has a negative impact on both learners 'ability and teachers' ability to achieve good results.

Data findings at technical and practical level of reflection indicate that textbooks (hard-ware resources) do assist learners in their understanding of the physical sciences. In support of this, the Department of Education (2011) also articulates that each learner should be in possession of a relevant textbook and stationery. On the contrary, it is found that there are often not enough textbooks for the number of learners present in a class. The Department provision model which is based on Post Provision Norm (PPN) also has challenges in small schools in rural areas. Hence, this model stipulates the amount of money to be allocated to the schools which ends up disadvantaging the school in terms of buying all required resources for the school.

Thus, the quality and practicability of materials should be evaluated in the teaching of a subject (Khoza, 2015a). Furthermore, findings indicate that few teachers are able to use computers during a lesson. This suggests that some schools in rural areas still do not have electricity to run computers necessary for teaching. In addition, from the teachers' accounts it is clear that they were not aware of ideological-ware during the first phase of the study. It was only after the intervention programme was administered that teachers began to realise the importance of ideological-ware resource in the teaching of CAPS. In other words, teaching methods play a critical role when it comes to resources.

The CAPS document does specify the hard-ware resources to be used during experiments. Neither does it specify or recommend the types of textbooks to be used in teaching physical science. As a result, a teacher can use any textbook of his/her choice which undermines consistency in the implementation of the CAPS curriculum. Furthermore, CAPS does not address soft-ware and ideological-ware resources. This creates confusion for teachers and may have a negative effect on the learners' results. Teachers end up using their own thousand theories of teaching and of hardware and software resources (Kehdinga, 2014a). As a result, teachers choose different books which works against CAPS as a performance curriculum.

5.3. 8 Location and time

The literature reveals that location and time play a vital role in teaching of curriculum. For instance, time and location determined should suit the discussions, book reading and practical experience to learners (Allery & Psillos, 1992 & Khoza, 2013b). Based on the different levels of reflection, the literature proposes teaching hours, teaching space/venue, and the inclusion of internet spaces. The literature argued that teaching hours and venues are key propositions in location and time concepts. As a result, physical location influences teaching process and may encourage assessment and group work among learners. Thus, Nakpodia (2013) believe that school principals should create a favourable environment and allow enough time for the teaching of the physical science curriculum. The literature identifies time and hours, stipulated by the Department, to be used for teaching during the school day. Furthermore, the CAPS documents also specify hours per content topic to be used (CAPS, 2011). This makes it easier for teachers to plan and implement the Physical Science CAPS. The location should fit the modern and local context. The learning time should fit working hours and after work hours (Berkvens et al. 2014). Furthermore, Khoza (2014b) raises the concern that teachers have little choice but to act as technicians in following the already designed curriculum within the specified time-frame. The findings from the literature indicate that the internet is the scarcest space used in rural school.

The CAPS document does specify the experiments that need to be conducted yet there are no laboratories built (location) within schools studied. It also stipulates the resources to be used when conducting experiments, but these are scarce in rural schools. CAPS ultimately want learners to undertake investigations but this is impossible without resources and internet connections in schools. On the other hand, CAPS does specify a time allocation, per content topic, of four hours per week which does help to give teachers direction in their planning. As a result, teachers do not have access to resources or laboratories but they have fours per week, so that makes it easy to teach. This helps teachers to plan accurately.

The data findings from the teachers suggest that some teachers are still not aware of the allocated time for Physical Science CAPS, since some teachers conduct five or six hour periods instead of four hour periods as per CAPS document. Furthermore, they use classrooms instead of laboratories, especially teachers from rural schools, for delivering both the content and practical work. These spaces are not conducive for teaching and learning since they are not electrified and the windows are often broken. Findings indicate that the time allocated is not enough to deliver the content and suggests that teachers organize extra-classes which are not remunerated. From this, it is clear that teachers end up being discouraged from conducting extra-classes. This adds to the possibility of a high learner failure rate. It is clear from the findings that internet space is not often used in rural schools since they are seldom connected or electrified. This is a major drawback to the teaching of the Physical Science CAPS in an increasingly modern, technological, world.

5.3. 9 Assessment

Assessment is the most vital component of the teaching of Physical Science CAPS (Hoadley & Jansen, 2013). In reference to this, the literature indicates three types of assessment that any physical science teacher should be aware of, including formative, summative and continuous assessment (Hoadley & Jansen, 2013). The literature indicates that formative assessment is done to informally evaluate the learner's progress and is not intended for grading purposes, whereas summative assessment is done for grading purposes. In addition, continuous assessment is taken as assessment that is done per unit intervals of learning which involves school term (Hoadley & Jansen, 2013). As a result, each term includes established tasks needed for continuous assessment purposes. The literature argument is more on summative assessment. This assessment is recorded with an aim of checking learners' progress. Thus, control tests and final examinations administered in the Physical Science CAPS fulfill the purposes of summative assessment. The Physical Science CAPS is measured with Grade 12 results. This clearly shows that summative assessment is done to inform the teacher, learner and parent about the learner's progress (Hoadley & Jansen, 2013). In other words, summative assessment gives a clear signal on whether or not the teaching of Physical Science CAPS has successfully taken place.

The CAPS document does clearly describe all three types of assessment proposed by the literature. All kinds of formative assessment, (which includes homework, class work, and observation) are said to be undertaken when assessing Grade 12 Physical Science learners. Control tests and experiments are described, per term, as continuous assessment and forms part of summative assessment. The assessment guidelines document indicates the scope of what is going to be assessed in the final examination (summative assessment). The programme of assessment is included so that teachers know what and when to assess (CAPS, 2011). Thus, as the intended curriculum, CAPS, is relevant, consistent, and suitable for the teaching process (Berkvens et al., 2014). In other words, teachers should assess while they teach because teaching without assessing is like eating without digesting.

From the first phase of data generation, teachers reflected only on formative and summative assessment. These reflections were on a technical and practical level. Whereas, during the second phase of the study, after a critical level of reflection, it was found that teachers did take a stance in improving their teaching practice through continuous assessment (CASS). Data findings indicated that teachers give home and class assignments (formative assessment), control tests and experiments (summative assessment) and examinations. It was clear from the findings that the CAPS document does not gives any examples of test, class work and examination, and that teachers use various other resources with assessment activities to assess learners. This suggests that learners from different schools can be assessed on a same subject through different tools or tasks. This practice may yield a different attained curriculum (grade 12 results) instead of the intended curriculum (CAPS). Furthermore, teachers did not reflect on cognitive levels of blooms taxonomy when assessing whether learners achieved learning outcomes (Kennedy et al., 2006). This indicates that teachers do not read CAPS document so that they may be able to use blooms taxonomy when assessing learners. Grade 12 Physical Sciences teachers are found to be following the programme of assessment as suggested by the CAPS document. (Illustrated in Table 5.3, Table5.4 and 5.5 below).

<table>
<tr><td colspan="6">Programme of assessment for grade 12</td><td>External assessment</td></tr>
<tr><td colspan="6">Continuous Assessment task (25%)</td><td>End of the year assessment</td></tr>
<tr><td colspan="2">Term 1</td><td colspan="2">Term 2</td><td colspan="2">Term</td><td>Term 4</td></tr>
<tr><td>Type</td><td>%</td><td>Type</td><td>%</td><td>Type</td><td>%</td><td rowspan="3">Final exam(2x150 marks giving a total of 300 marks for P1 and P2)</td></tr>
<tr><td>Experiment</td><td>15</td><td>Experiment</td><td>15</td><td>Experiment</td><td>15</td></tr>
<tr><td>Control test</td><td>10</td><td>Mid-year examination</td><td>20</td><td>Trail examination</td><td>25</td></tr>
<tr><td colspan="2">Total marks: 25 marks</td><td colspan="2">Total marks: 35 marks</td><td colspan="2">Total marks: 40 marks</td><td>Total marks: 300 marks</td></tr>
<tr><td colspan="7">Total marks: 400 marks</td></tr>
<tr><td colspan="7">Final mark= 25%(continuous assessment) + 75%(final exam)= 100 %</td></tr>
</table>

Table 5.3: Programme of assessment for Grade 12.

Rating codes	**Description of competence**	**percentage**
7	Outstanding achievement	80 – 100
6	Meritorious achievement	70 – 79
5	Substantial achievement	60 – 69
4	Adequate achievement	50 – 59
3	Moderate achievement	40 – 49
2	Elementary achievement	30 – 39
1	Not achieved	0 – 29

Table 5.4: Codes and percentage for recording and reporting.

Paper	Content	Marks	Weighing of questions across cognitive levels (blooms' taxonomy)			
Paper 1: physics part	Mechanics	75	Level 1 (recall)	Level 2 (comprehension)	Level 3 (analysis &application)	Level 4 (evaluation & synthesis)
	Waves, sound and light	40	15%	35%	40%	10%
	Electricity	35				
Paper2: chemistry focus	Chemical change	60	15%	40%	35%	10%
	Chemical systems	20				
	Matter and materials	70				

Table 5.5: Weighing of questions across cognitive levels.

5. 4 Suggestions for further research

The following recommendations are suggested for further research

- Further research must to be made on the teaching of Grade 12 Physical Science CAPS especially in rural schools. The curricular spider-web concepts should be considered in order to improve and transform the teaching practice for the positive achieved curriculum
- The literature review indicates that there are few studies on teachers' reflections on the teaching of the Physical Science CAPS. Thus, in order to close this gap, it would be useful for further studies to be conducted in other circuits outside of Ceza Circuit.
- Another potential study that is raised from the findings is the influence of critical reflection, as compared to technical and practical level reflection, in the teaching of Physical Science CAPS by teachers.
- The importance of teachers' reflection in the implementation of the Physical Science curriculum.

5. 5 Recommendations

5.5. 1 Recommendation 1

It is necessary for CAPS to be reviewed in order to redefine the Physical Science subject rationale. This will allow teachers to better enjoy the physical science curriculum. As a result, the CAPS documents (intended curriculum) may be useful to teachers, learners and the society in general. A clear subject rationale may also ensure the curriculum is achieved and that all stakeholders are able to work together to contribute towards improved implementation of the curriculum. It is also recommended that teachers need to be involved in researching and coming up with innovative and constructive input on how CAPS can be improved. In this respect, teachers should be involved during the designing of the intended curriculum for transformation and emancipatory purposes. Furthermore, if the Department of Basic Education administers intervention programmes, teachers may always possess the critical level of reflections needed to correctly teach Physical Science CAPS.

5.5. 2 Recommendation 2

Findings indicate that when teachers are staying next to schools, they easily access the teaching space at any time. As a result, there is a need for cottages as a nearby accommodation for teachers by schools to enhance better performance. Further to this, Easy access to schools including good incentives of rural allowance can also attract highly qualified teachers to be employed in rural schools. This may enhance the good and positive attained curriculum.

5.5. 3 Recommendation 3

Curriculum content workshops organised by the Department should not only address the content but also the goals of teaching and should clearly demonstrate how they are linked to the content. When teachers are not clear about goals, the teaching of physical science might be distorted. This recommends huge intervention by Department officials. As a result, subject advisors may intervene in order to address the issue of goals towards the teaching of Physical Science CAPS during school visits. Various documents on aims, objective and learning outcomes should be provided to teachers in order to transform their teaching practice. Teachers should also read the CAPS document in order to understand blooms taxonomy and how to apply it efficiently. This may ensure that the content taught is properly aligned with the goals.

5.5. 4 Recommendation 4

The Department of Education should ensure that all those teaching the Physical Science CAPS are qualified. A pre-employment test to determine whether or not a teacher possesses the necessary content knowledge should be administered. The issue of a teacher being good in paper 1 or paper 2 influences learners to enjoy one part of physical science. However, in order to avoid physic that, science topics should be taught by two separate teachers. This will improve the teaching practices of physical science curriculum. Teachers should be trained in both parts of physical science in order to avoid influence made by teachers to learners. Laboratories should be built in rural public schools in order to eradicate historic imbalances and to make it easier for teachers to conduct practical work with learners. Further to this, more bursaries should be provided to teachers that intend to teach physical science in order to prevent a shortage of qualified educators on the subject.

5.5. 5 Recommendation 5

It is then recommended that the CAPS documents should outline a variety of required or relevant activities according to their different types (formal, Informal and CASS) in order to standardise the intended curriculum and ensure that it is implemented easily and without confusion among teachers. The Department should recommend only one or two textbooks for Physical Science CAPS in order to ensure consistency and practicality of teaching activities. It is recommend that teachers should familiarise themselves with various studies, including the CAPS document, so that they may understand various types of activities recommended by CAPS and other literature. The Department should put more focus on informal activities because they constitute formal activities. For instance, written class activity constitute control test for learners.

5.5. 6 Recommendation 6

Teachers have been made technicians (Mchunu & Msibi, 2013 & Khoza, 2014a) in the teaching of CAPS since teachers are directed to teach without knowing their teaching roles. It is therefore recommended that teachers themselves understand, through their own research, their basic role in teaching the curriculum CAPS. The CAPS document may be reviewed in order to cater to the issue of addressing teachers' role by stating the kind of approach the intended curriculum CAPS adopts. The Department should organise fruitful workshops in order to address the concept of teaching physical sciences.

5.5. 7 Recommendation 7

It is necessary for the Department to revise the PPN model in order to cater for poorer schools, mostly found in rural areas, in such a way that the provision of resources is rationed irrespective of the school size, for the effective teaching of Physical Science CAPS. Recommending one or two fruitful textbook will minimize the distortion of physical science content. A retrieval policy may be implemented in schools to maintain procured textbooks in order to avoid loss of textbooks by learners. In the increasingly technological world, it is recommended that the Department ensure that all schools are electrified and have at least one computer connected to the internet. This may enhance the quality and speed of communication between the schools and Department officials. Department officials should review the CAPS document and address the issue of ideological-ware resources in schools.

5.5. 8 Recommendation 8

It is necessary that the Department provides schools with a conducive infrastructure (classroom and laboratories) that would enable teachers to implement the physical science curriculum. School principals should use school funds to maintain classrooms. The Department should also provide internet-available spaces in schools so that it would be easier for teachers to immediately access relevant information. It is also advisable that the Department pay teachers for extra-classes. Zululand district officials in particular, should recognise teachers producing good results through certification.

5.5. 9 Recommendation 9

Teachers should engage themselves in school-based moderation and cluster moderation which may be of assistance in ensuring that assessment is done according to the CAPS document. CAPS documents should be reviewed to provide examples of all assessment tasks per prescribed content. This will avoid different formative and continuous task that make one summative task for learners. Those teaching Physical Science CAPS should familiarise themselves with Blooms taxonomy in order to achieve the best learning outcomes. Training of all Physical Science teachers on all assessment criterion and tools used for Grade 12 physical assessment may also ensure that learners receive the same, consistent, information for examinations.

5. 6 Study limitations

Due to the fact that I am a Grade 12 Physical Sciences CAPS teacher within the same circuit (Ceza), I was very careful to avoid being bias and having a personal interest while conducting this study. However, I did not raise any opinions, knowledge and experiences that I had about the study. In order to overcome this, I therefore allowed the participants to provide their own data without being influential to them during our interview process. One of the limitations, like all other qualitative research, is that this study is small scaled and thus its findings and results are subjective, personal and contextual and therefore cannot be generalized. Thus, the findings of this study can be used only for the sake of transferability rather than generalisation.

5. 7 Conclusion

The main purpose of this study was to understand teachers' reflections, explain what informs these reflections and explain the lessons that can be learned from their reflections on the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools. In informing these objectives, research questions were asked: 1. what are the teachers' reflections? 2. Why do teachers reflect in particular ways? And 3. What lessons can be learned from the teachers' reflections on the teaching of Grade 12 Physical Sciences CAPS in Ceza Circuit rural schools? The main answer for the first question, according to the findings from the literature, is that teachers' reflections can be found at the technical, practical and critical levels of reflection (Percy, 2006 & van Manen, 1977). These reflections can be influenced by personal, societal and content rationale (Berkeven et al., 2014). Furthermore, based on the second question, the teachers' teaching background is based either on everyday knowledge or on school knowledge and this prompts them to reflect in a particular way (technical, practical and critical level/way) as displayed in the findings. The answers to the third question indicate that teachers can improve their teaching practices, and can be transformed and empowered after intervention programmes have been administered. This was evident when, during the second phase of the research, teachers were transformed and were able to reflect critically on each concept of the curriculum spider-web.

In this chapter a summary of this study have been provided and the findings from the literature, CAPS document and data analysis were compared. Recommendations formulated from each curriculum spider-web element have been also made. Each element of the curricular spider-web is vital but all other concepts revolve around the rationale concepts in the teaching process. Further to this, while addressing the spider web concepts in the intended curriculum (CAPS), the issue of quality assurance (relevance, sustainability, consistency and practicality) should also be taken into consideration (Berkeven et al., 2014). Hoadley and Jansen (2013) and Khoza (2015a) believe that a curriculum can either be competence based or performance based in order to determine the ideological-ware. Thus, the teachers' reflections indicated that they used both teacher-centred as well as learner-centred approach in their teaching process. As a result, this raised a lot of questions on whether or not CAPS, as our intended curriculum, is able to provide a high quality of education for South Africans students.

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Annexures

1. Annexure A – Letter to principle

Mpungose CB
P.O.Box 610
Ulundi
3838
18 February 2015

Dear School Principal

Application for Permission to Conduct Research at Bantubaningi high School

My name is Cedric Bheki Mpungose. I am a Curriculum MEd. candidate studying at the University of KwaZulu-Natal, Edgewood campus, South Africa. I am interested in exploring teachers' reflections on the teaching of grade 12 physical sciences CAPS in rural schools at Ceza Circuit.I have observed that teachers are not aware of issues between planned curriculum (intended) and enacted (implemented) curriculum which yield in different results (attained curriculum) in schools. I am doing an action research, thus I am also involved in doing this research since I am also teaching grade12 physical sciences CAPS. Therefore, to gather the information, the above-mentioned educational institution under your supervision is of paramount Importance for this research to be successful. Therefore, I would like to request to use your school and grade 12 Physical science CAPS teachers to conduct this research project. Please note the following:

- The school and teachers' confidentiality is guaranteed.
- The interview, reflective activity and focus group discussion may last for about 1 hour.
- Any information given by your teachers cannot be used against the school, and the collected data will be used for purposes of this research only.
- There will be no limit on any benefit that the school and teachers may receive as part of participation in this research project;
- Data will be stored in secure storage and destroyed after 5 years.
- Teachers have a choice to participate, not participate or stop participating in the research. The school and teachers will not be penalized for taking such an action.
- The school and teachers are free to withdraw from the research at any time without any negative or undesirable consequences;

- Real names of the school and teachers will not be used, but symbols such as A, B, C, D, E and F will be used to represent school and teachers' names;
- The research aims at knowing the challenges of your community relating to scarcity, peoples' movement, and effects on peace.
- School and teachers involvement is purely for academic purposes only, and there are no financial benefits involved.

I can be contacted at:
Email: mabhizamp@gmail.com
Cell: +27 72 0645 5606.

My supervisor is Dr. SB Khoza who is located at the School of Education, Edgewood campus of the University of KwaZulu-Natal.
Contact details: email: khozas@ukzn.ac.za Phone number: +27312607595.

Discipline Co-ordinator is Dr. LR Maharajh,
Curriculum Studies, School of Education,
Edgewood College, University of KwaZulu-Natal
(Tel) 0312602470(Cell) 0822022524, Email: maharajhlr@ukzn.ac.za

You may also contact the Research Office through:
Ximba Phumelele
HSSREC Research Office,
Tel: 031 260 3587 E-mail: ximbap@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I……………………………………………………………………………… (Full names of the school principal) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent for the school and teachers to participate in the research project.

I understand that the school and teachers are at liberty to withdraw from the project at any time, should they so desire.

SIGNATURE OF PRINCIPAL DATE

…………………………………. …………………………………

SCHOOL STAMP

2. Annexure B: Letter to the Department

Mr Mpungose CB
P.O.Box 610
Ulundi
3838
03 March 2015

The District Director
ATT: Mr. W du Plooy
P/Bag X9330
Vryheid
3100

Application for Permission to Conduct Research in schools at Mahlabathini circuit in Zululand district.

My name is Cedric Bheki Mpungose. I am a Curriculum MEd. candidate studying at the University of KwaZulu-Natal, Edgewood campus, South Africa. I am interested in exploring teachers' reflections on the teaching of grade 12 physical sciences CAPS in rural schools at Ceza Circuit.I have observed that teachers are not aware of issues between planned curriculum (intended) and enacted (implemented) curriculum which yield in different results (attained curriculum) in schools. I am doing an action research, thus I am also involved in doing this research since I am also teaching grade12 physical sciences CAPS. The following schools are sampled to be used for this research project.

1.	Bantubaningi high school
2.	Ivungu high school
3.	Mhlambansila high school
4.	Mnyamana high school
5.	Phikwase high school
6.	Siyangempumelelo high school

Therefore, to gather the information or data, the above-mentioned educational institution under your supervision is of paramount Importance for this research to be successful. Therefore, I would like to request to use these schools and their grade 12 Physical science CAPS teachers to conduct this research project. Please note the following:

- The school and teachers' confidentiality is guaranteed.
- The interview, reflective activity and focus group discussion may last for about 1 hour.
- Any information given by your teachers cannot be used against the school, and the collected data will be used for purposes of this research only.
- There will be no limit on any benefit that the school and teachers may receive as part of participation in this research project;

- Data will be stored in secure storage and destroyed after 5 years.
- Teachers have a choice to participate, not participate or stop participating in the research. The school and teachers will not be penalized for taking such an action.
- The school and teachers are free to withdraw from the research at any time without any negative or undesirable consequences;
- Real names of the school and teachers will not be used, but symbols such as A, B, C, D, E and F will be used to represent school and teachers' names;
- School and teachers involvement is purely for academic purposes only, and there are no financial benefits involved.

There following plan is used to complete this research project.

Time Frame	Guidelines
01 Dec 2014 – 31 Jan 2015	Research proposal development and revision
01 Jan 2015	Final research proposal and Ethical clearance
01 Feb 2015 – 28 Feb 2015	Literature review and theoretical framework
01 March 2015 – 30 March 2015	Data generation methods
01 April 2015 – 30 April 2015	Research design and methodology chapter submissions
01 May 2015 – 31 May 2015	Analysis of data generation
01 June 2015 – 30 June 2015	Research findings and discussions chapter submissions
01 July 2015 – 31 July 2015	Writing summery of the study with chapter one
01 Aug 2015 – 30 Aug 2015	Revision of all chapters and submissions (1st draft)
01 Sept 2015 – 31 Sept 2015	Second draft submission after corrections
10 October 2015	Turnitin the project
15 October 2015	Send project to the editor
25 October 2015	Doing correction from the editor
27 October 2015	Submission of the third draft after turnitin and editor
31 October 2015	Submission of final research report for examination

I can be contacted at:
Email: mabhizamp@gmail.com
Cell: +27 72 0645 5606.

My supervisor is Dr. SB Khoza who is located at the School of Education, Edgewood campus of the University of KwaZulu-Natal.
Contact details: email: khozas@ukzn.ac.za Phone number: +27312607595.

Discipline Co-ordinator is Dr. LR Maharajh,
Curriculum Studies, School of Education,
Edgewood College, University of KwaZulu-Natal
(Tel) 0312602470(Cell) 0822022524, Email: maharajhlr@ukzn.ac.za

You may also contact the Research Office through:
Ximba Phumelele
HSSREC Research Office,
Tel: 031 260 3587 E-mail: ximbap@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I……………………………………………………………………… (Full names of the District Director) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent for the school and teachers to participate in the research project.

I understand that the school and teachers are at liberty to withdraw from the project at any time, should they so desire.

SIGNATURE OF DISTRICT DIRECTOR DATE

…………………………………. …………………………

STAMP

3. Annexure C: Consent form for teachers

Mpungose CB

P.O.Box 610

Ulundi

3838

18 February 2015

Dear Participant

INFORMED CONSENT LETTER

My name is Cedric Bheki Mpungose. I am a Curriculum MED candidate studying at the University of KwaZulu-Natal, Edgewood campus, South Africa.

I am interested in exploring teachers' reflections on the teaching of grade 12 physical sciences CAPS in rural schools at Ceza Circuit.I have observed that teachers are not aware of issues between planned curriculum (intended) and enacted (implemented) curriculum which yield in different results (attained curriculum)in schools. I am doing an action research, thus I am also involved in doing this research since I am also teaching geade12 physical sciences CAPS. Therefore, to gather the information, I am interested in asking you some questions.

Please note that:

- Your confidentiality is guaranteed as your inputs will not be attributed to you in person, but reported only as a population member opinion.
- The interview may last for about 1 hour and may be split depending on your preference.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.
- There will be no limit on any benefit that the participants may receive as part of their participation in this research project;
- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.
- The participants are free to withdraw from the research at any time without any negative or undesirable consequences to themselves;
- Real names of the participants will not be used, but symbols such as A, B, C, D, E and F will be used to represent participants' names;

- The research aims at knowing the challenges of your community relating to resource scarcity, peoples' movement, and effects on peace.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.
- If you are willing to be interviewed, please indicate (by ticking as applicable) whether or not you are willing to allow the interview to be recorded by the following equipment:
-

	Willing	Not willing
Audio equipment		
Photographic equipment		
Video equipment		

I can be contacted at:

Email: mabhizamp@gmail.com

Cell: +27 72 0645 5606.

My supervisor is Dr. SB Khoza who is located at the School of Education, Edgewood campus of the University of KwaZulu-Natal.

Contact details: email: khozas@ukzn.ac.za   Phone number: +27312607595.

Discipline Co-ordinator is Dr. LR Maharajh,
Curriculum Studies, School of Education,
Edgewood College, University of KwaZulu-Natal
(Tel) 0312602470(Cell) 0822022524, Email: maharajhlr@ukzn.ac.za

You may also contact the Research Office through:

Ximba Phumelele

HSSREC Research Office,

Tel: 031 260 3587 E-mail: ximbap@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I………………………………………………………………………… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT DATE

……………………………………… …………………………………

4. Annexure D: Permission from the department

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries : Imibuzo : CMC: Co-ordinator Navrae :	Reference : Inkomba : RESEARCH APPROVAL Verwysing :	Date : Datum: 01/06/2015 Usuku:

The Principal
Magqezulana High School
Attention: Mr C.B. Mpungose
P.O. Box 610
Ulundi
3838

RE: APPROVAL TO CONDUCT RESEARCH IN SCHOOLS UNDER MAHLABATHINI CMC

- The above matter refers to your request dated 3 March 2015, where you requested to conduct a research in 6 schools namely **Bantubaningi High, Ivungu High, Mhlambansila High, Mnyamana High, Phikwase High and Siyangempumelelo High**.

- The approval to conduct this research in 6 schools is hereby granted. The approval is granted with the following conditions:-
  - **Teaching and learning/contact time should not be disturbed by this research.**
  - **Mr Mpungose will do the research on his time not during contact time.**

- Hoping that this will be in order.

KWAZULU-NATAL DEPARTMENT OF EDUCATION
UMPHATHI WE SEKETHE
CIRCUIT MANAGER
01 JUN 2015
MAHLABATHINI CIRCUIT OFFICE

CMC: Co-ordinator
Mr S.W. Mthethwa

...Together moving South Africa forward through quality education and skills development

KWAZULU-NATAL DEPARTMENT OF EDUCATION
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5. Annexure E: Permission from the University.

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

10 April 2015

Mr Cedric Bheki Mpungose 214581960
School of Education
Edgewood Campus

Dear Mr Mpungose

Protocol reference number: HSS/0290/015M
Project title: Teachers' reflections of the teaching of grade 12 physical science CAPS in rural schools at Ceza Circuit.

Expedited Approval

In response to your application dated 07 April 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

Please note: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

....
Dr Shenuka Singh (Chair)

/px

cc Supervisor: Dr SB Khoza
cc Academic Leader Research: Professor P Morojele
cc School Administrator: Ms B Bhengu, Ms T Khumalo & Mr S Mthembu

Humanities & Social Sciences Research Ethics Committee
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6. Annexure F: Reflective Activity

Full name: ___________________________________

School name: _________________________________

This Reflective Activity is for reflections of your teaching of grade 12 physical science CAPS. You may use various sources to complete this activity. Presents your reflections by following the curricular spider web themes/questions as follows.

1. Why are you teaching (Rationale/vision) Physical Sciences' CAPS?

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____

2. Towards which goals are you teaching (Aims/objectives/outcomes) Physical Sciences' CAPS?

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____

3. What content are you teaching in Physical Sciences' CAPS?

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4. Which activities/tasks are you using to teach Physical science CAPS?

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____

5. What resources are you using to teach Physical science CAPS?

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____

6. How do you facilitate learning (Teacher role) of Physical Sciences' CAPS?

____

____

7. How do you access (accessibility) the teaching of Physical Sciences' CAPS?

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____

8. Where and When are you teaching (Location) and (Time allocation) Physical Sciences' CAPS?

____

____

9. How do you assess learning (Assessment) of physical sciences CAPS?

____

____

7. Annexure G: Focus group discussions

Individual interviews

Full name: ___________________________________

This Individual interview is for reflections. This interview will require you to tell a story about the teaching of Physical Sciences' Curriculum Assessment and Policy Statement (CAPS) using Curricular Spider Web as a framework for the analysis. Presents your reflections by following the curricular spider web themes/questions as follows.

1. Why are you teaching (Rationale/vision) grade 12 Physical Sciences' CAPS?
2. Towards which goals are you teaching (Aims/objectives) grade 12 Physical Sciences' CAPS?
3. What are you teaching (Content) in grade 12 Physical Sciences' CAPS?
4. How are you teaching (Teaching activities) grade 12 Physical Sciences' CAPS?
5. With what are you teaching (Resources) grade 12 Physical Sciences' CAPS?
6. How are you facilitating teaching (Teacher role) of grade 12 Physical Sciences' CAPS?
7. With whom are you teaching (Grouping) grade 12 Physical Sciences' CAPS?
8. Where and when are you teaching (Location) and (Time) grade 12 Physical Sciences' CAPS?
9. How is your teaching (Assessment) of grade 12 physical sciences?

8. Annexure H: Semi-structure interview

Individual interviews

Full name: ___________________________________

This Individual interview is for reflections. This interview will require you to tell a story about the teaching of Physical Sciences' Curriculum Assessment and Policy Statement (CAPS) using Curricular Spider Web as a framework for the analysis. Presents your reflections by following the curricular spider web themes/questions as follows.

1. Why are you teaching (Rationale/vision) grade 12 Physical Sciences' CAPS?
2. Towards which goals are you teaching (Aims/objectives) grade 12 Physical Sciences' CAPS?
3. What are you teaching (Content) in grade 12 Physical Sciences' CAPS?
4. How are you teaching (Teaching activities) grade 12 Physical Sciences' CAPS?
5. With what are you teaching (Resources) grade 12 Physical Sciences' CAPS?
6. How are you facilitating teaching (Teacher role) of grade 12 Physical Sciences' CAPS?
7. With whom are you teaching (Grouping) grade 12 Physical Sciences' CAPS?
8. Where and when are you teaching (Location) and (Time) grade 12 Physical Sciences' CAPS?
9. How is your teaching (Assessment) of grade 12 physical sciences?

9. Annexure I: Turnitin Report