

AN INVESTIGATION ON HOW THE CHILD CENTRED APPROACH IS APPLIED IN THE TEACHING OF
NATURAL SCIENCE IN JOHANNESBURG EAST SCHOOLS.

by

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by

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the degree of

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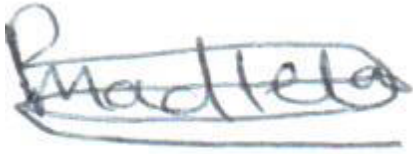
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November 2014

DECLARATION

Student number: 48031232

I Benkosi Madlela declare that this dissertation entitled, **An investigation on how the child centred approach is applied in the teaching of Natural Science in Johannesburg East schools** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

A handwritten signature in blue ink that reads "Benkosi Madlela". The signature is written in a cursive style and is underlined with a single horizontal line.

SIGNATURE
(Mr) Benkosi Madlela

27 November 2014
DATE

DEDICATIONS

To my parents Mr Jonathan J Madlela and Angelina Ndlovu nee Ncube who championed education, Christianity and uBuntu in my family. To my family who upheld the principles of Christianity, uBuntu and education.

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In order for this work to be a success many helping hands were stretched. I would like to express my gratitude to all those who assisted me with resources, expert advice, information as well as logistical support during the course of compiling this dissertation. Worth mentioning are UNISA students Funding Department for financing the tuition and research of this dissertation, my supervisor Dr Prem J Heeralal who gave expert advice right from the project proposal phase up to the conclusion chapter and summary of the study, the Gauteng Department of Education (GDE) for allowing the researcher to research in their schools, Headmasters in Johannesburg East for allowing the researcher to carry out the study in their schools, Natural Science teachers in Johannesburg East schools who participated in the study, my family for their continued support and encouragement especially my young brother Sobantu Madlela who provided advise on how to sample the schools that participated in the study, and also provided the much needed logistical support during data collection exercise. All those who offered a helping hand during data collection period are appreciated.

ABSTRACT

The study investigated how the child centred approach is applied in teaching Natural Science (NS) in Johannesburg East schools. Most attention was paid on which teaching methods were used and how they were used to teach NS. Data was collected from 5 randomly selected schools in Johannesburg East through observations of Natural Science teachers teaching, and focus group discussion with them. Data presentation and analysis revealed that NS teachers who participated in the study used a limited range of child centred teaching methods. They only used experiments, class activities, as well as question and answer method. Literature review revealed that there are numerous child centred teaching methods that NS teachers can use. Some of these methods are brainstorming, discussions, games, group/pair work, field trips, case studies and assignments, using Information and Communication Technology (ICT), debates and facilitation. The majority of teachers still used the out-dated lecture method contrary to the Curriculum Assessment Policy Statement (CAPS) 2012 documents that call for an end in the use of traditional teaching methods such as the lecture method. The study also revealed that there are certain challenges and factors that inhibit the implementation of the child centred approach in NS. These challenges among others include the teacher centred curriculum which dictates the pace and content to the child, lack of adequate NS resources, big volumes of learners in classes, different abilities, talents, interests and skills possessed by learners, learners' lack of discipline, as well as shortage of qualified NS teachers. All these were seen as inhibiting factors in the implementation of the child centred approach in NS. The study among other recommendations recommended that, in order for the child centred approach to be implemented successfully the Ministry of Basic Education should develop a child centred curriculum that does not dictate the pace to the child. The Ministry as well should come up with a specific or customised child centred approach model that is relevant to NS as a subject, in-service all NS teachers and empower them with the child centred teaching methods, principles and strategies, capacitate all schools with all necessary resources such as qualified NS teachers as well as relevant chemicals, materials, apparatus and information and communication technology infrastructure designated for NS.

Key words: Child, Centred, Approach, Implementation, Natural Science.

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DEFINITION OF TERMS & ACRONYMS

1. CHILD CENTRED APPROACH - the child centred approach is defined by Mayer (1998) cited in Barbara (2007) as a learning process whereby learners work individually or in small groups to explore, investigate, and solve authentic problems and become actively engaged in seeking knowledge and information rather than being passive recipients.
2. CAPS – Curriculum Assessment Policy Statement
ICT - Information and Communication Technology
ANC – African National Congress
UNISA – University of South Africa
OBE – Outcomes Based Education
NCS - National Curriculum Statement
RNCS – Revised National Curriculum Statement
NS- Natural Science

Chapter 1: Introduction and overview.

1. Introduction.

The post-apartheid South Africa, wishes to provide all its children with quality education that will empower them with skills, knowledge and values that will allow them to contribute to their own success, as well as the success of their families, communities and the nation at large. Curriculum Assessment Policy Statement (CAPS) (2012) argue that learners can only acquire skills and knowledge when they are involved and given a room to play an active role in their own learning, as opposed to being forced to learn through rote memorisation. This means that meaningful learning can only take place in classrooms if child centred teaching methods are used appropriately. This study will investigate how the child centred approach is applied in the teaching of Natural Science in chosen schools in Johannesburg East, Gauteng Province.

1.1 Back ground of the study.

The History of South African education reveals that South African education has been shifting from one orientation to another. South African education evolved from Bantu education during apartheid era to OBE popularly known as curriculum 2005 soon after 1994 when the democratically elected ANC government assumed power in South Africa. It continued to evolve right up to the present day CAPS, Thomas (2012). This assertion by Thomas concurs with other empirical evidence which contends that South African curriculum has been changing from one orientation to another from time immemorial up to date. This is reflected by Le Roux (2010) in ACENSH/2/2011-2013) who portrays the South African curriculum changing from National Curriculum Statement (NCS), to Revised National curriculum statement (RNCS). He goes on to quote the Department of Basic Education announcing yet another South African curriculum change in September 2010. The Department of Basic Education cited in Le Roux (2010) is highlighted as saying that, the Curriculum Assessment Policy Statement (CAPS) were put forward to assist in the improvement and implementation of the National Curriculum Statement. These CAPS documents according to the Department of Education (2010) were supposed to be implemented in January (2011), but due to the operational difficulties such as having appropriate learning material available in time for the start of the school year in 2011, it was proposed that implementation should be held back until 2012. The Department of education in 2012 announced that the CAPS (2012) documents had been officially adopted. Teachers were trained and oriented so that they could acquaint themselves with these documents. The CAPS (2012) documents are of great interest to this study, because they call for an end in the use of traditional rote learning in all South African schools, and an introduction of the child centred approach to teaching and learning in schools.

The constitution of the Republic of South Africa No. 108 of 1996, chapter2, section 29-education, spells out that:

(1) Everyone has a right:

- a) To basic education, including adult basic education, and
- b) To further education, which the state, through reasonable measures, must make progressively available and accessible.

In the quest of fulfilling the principles of the Constitution, the Ministry of Basic Education through CAPS (2012) introduced the child centred approach in order to ensure that all learners experience interesting education that enables them to be analytical and critical thinkers capable of changing their lives and that of their societies.

Henson (2003) asserts that empirical evidence proves that the child centred approach is as old as education its-self. He goes further to attest that the signs of the learner centred education began to show right from the dawning of education, and according to him formal education can be traced back to the Sumerians and the development of written language (around 3500 BC). Within five hundred years Chinese had also established formal schools where early teachers emphasised individual character and citizenship. Seemingly the earliest individual teachers to have a profound, direct effect on the learner centred approach were the Chinese philosopher Confucius (551 B.C-479 BC), and the Greek Philosopher Socrates (460-399 B.C). Ozmon & Craver (1999:105) cited in Henson (2003) argue that Confucius stressed character and citizenship, while Socrates stressed the individual. They believed that every person must strive for the continual development of self until excellence is achieved.

The earliest known formal teaching method was the tutorial method. For five thousand years the tutorial method continued to dominate. Although the English Philosopher John Locke (1632-1704) recommended its use, he introduced the concept, tabula rasa or blank slate, meaning that at birth the child is a blank slate, and the only way to fill it is through having experiences, feeling these experiences and reflecting on them Henson (2003). This proves that Locke believed that the mind gets its understanding from experience. Stimulated by Locke's philosophical assertion philosophers like Jean Jacques Rousseau, and other Philosophers who were inspired by Rousseau and continued to inspire others explored the breadth and depth of the child centred approach to teaching and learning.

The child centred approach is highlighted by Weimer (2002) as an approach to teaching and learning that has been so popular in the 20th and 21stcenturies. He goes on to say that the main idea of this approach is to involve learners during the learning process as opposed to having the teacher dominating the whole learning process, with learners playing a passive role as if the teacher is a fountain of knowledge and learners are empty vessels that need to be filled in with information.

On the other hand Mayer (1998) cited in Barbara (2007) argues that the child centred approach is a learning process whereby learners work individually or in small groups to explore, investigate, and solve authentic problems and become actively engaged in seeking

knowledge and information rather than being passive recipients. She continues to assert that, in traditional learning mode, the teacher basically controls the instructional process. The content is delivered to the entire class, and the teacher tends to emphasise factual knowledge, and the focus of learning is on the content, that is how much material has been delivered, and how much have students learnt. This shows that this traditional learning mode tends to be passive and learners play little part in the learning process. Contrary to what takes place in the traditional teaching and learning approach, Mayer (1998) cited in Barbara (2007) attests that in the child centred approach, learners play an active part in the learning process. They become autonomous learners who are actively engaged in constructing meaning within the context of their knowledge, experiences and social environments. She proceeds to say that learners become successful in constructing knowledge through solving problems that are realistic, and they usually excel when they work collaboratively with others. All this means that the child centred approach is learner centred as opposed to teacher domination. This is in line with Weimer's (2002) assertion that, the learner centred paradigm departs from traditional teaching models by focusing on learners more than teachers, and learning more than teaching. He proceeds to say that, learner centred teaching represents a paradigm shift from traditional teaching methods by focusing on how students learn instead of how teachers teach. In light of this according to Weimer (2002) teachers should therefore ask them-selves the following fundamental questions: How can I improve my students' learning? Instead of asking themselves how can I improve my teaching? This should be the case because in the child centred approach what matters is how much have students learnt, as opposed to how much has the teacher taught? The teacher can teach through wrong methods for some hours and learners can still fail to grasp or to understand concepts being taught. The teacher there-fore has to be concerned about whether learners managed to grasp concepts than being concerned about how much chunks of information he/she has dished out in class.

Weimer (2002) attests that the use of child centred teaching methods have the following benefits:

- Responsibility is shared between the teacher and the learner.
- Learners develop learning skills for further education.
- Learners become self-directed lifelong learners.
- Learners are enabled to assess their own learning, and they become proficient in self-assessment.
- Learners also become proficient with information literacy skills, such as assessing and evaluating sources of information, so that they can use internet information wisely.

In line with Weimer (2002), McCombs & Whistler (1997) assert that the learner centred approach has vast benefits such as developing learners' thinking, communication and social skills. They go on to say that it helps learners to transfer skills to the real world, promotes

intrinsic motivation to learn, cultivate the learners' sense of responsibility in learning, while at the same time providing opportunities for higher order thinking as opposed to passive listening.

Bell (1999) contends that empirical evidence has proven that there are many child centred teaching methods that teachers can use in class. Which method to use according to him is determined by a number of factors, for example availability of resources, the topic being covered, calibre of learners, as well as the teachers' expertise and experience on particular methods. Bell (1999) goes on to say that it is therefore important for the teacher to choose an appropriate method for the lesson than to choose for the sake of choosing.

Authorities such as Bell (1999), McInnis (2000), Burdett (2003), Erickson (2007), Thornburg (2005), suggest the following child centred methods and strategies to teaching and learning in classrooms: Brainstorming, group and pair work, debates, using ICT, case studies, discussions, questioning, class activities and assignments, laboratory teaching, facilitation, project and library methods.

Interestingly CAPS documents for Natural Science Grades 7, 8 and 9, July 2012 advocates for the use of child centred teaching methods in class when teaching Natural Science. CAPS (2012) state the general aim and principles of the South African curriculum as follows:

(a) CAPS 2012 documents Grade R-12 give expression to the knowledge, skills and values worth learning in South African schools. The 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.

(c) CAPS (2012) document Grade R-12 is based on the following principle:

1. **Active and critical learning:** encouraging an active and critical approach to learning, rather than rote and uncritical approach to learning of given truths.

Of great emphasis in the CAPS (2012) documents is a shift from the traditional, boring rote learning and memorisation to more interesting, critical and motivating child centred teaching methods when teaching Natural Science in classrooms.

In order to achieve the CAPS (2012) document Grade R-12 principles that advocate for the attainment of high knowledge and high skills through active and critical learning, both the teacher and the learner have to play a dynamic role in a Natural Science class. The teacher has to play the role of the facilitator. This is supported by Chan (2009) who argues that in the child centred approach the teacher assumes the role of a facilitator of learning in class. This means that the teacher's role is not to dominate learning in class, but to guide and direct learning. On the other hand learners as well have a role to play in class. They are not supposed to play a passive role. Hadson (2008) asserts that in a child centred approach

learners have to be actively involved. In the same perspective Blumberg (2008) is of the opinion that learner centred teachers do not employ a single teaching method, but they employ a variety of different types of methods that shift the role of teachers from givers of information to facilitators of student learning. On the other hand Thornburg (2005) contends that one of the essentials of good teaching in the child centred environment is to move from the known to the unknown, simple to complex in order to enable learners to develop their understanding in terms of what they already know, allowing them to construct and climb a scaffold of understanding. In the child centred approach, learners themselves have a great role to take full responsibility of their own learning by taking a centre stage during the lesson. Learners are therefore supposed to research so that during the lesson they become active participants who play a vital role, than being passive listeners who wait to be spoon fed by the teacher always.

1.2 The problem statement

In 2012 the Department of Basic Education introduced the new curriculum CAPS 2012. This new curriculum calls on teachers to stop using traditional teaching methods of rote learning and memorisation, and adopt more interesting and creative child centred teaching methods when teaching Natural Science (NS). CAPS documents 2012 makes it a requirement for all Natural Science teachers to use child centred teaching methods, but the documents do not elaborate on which child centred teaching methods should be used and how they are supposed to be used. In light of this the study investigated how the child centred approach is implemented, which child centred teaching methods are used and how they are used in teaching Natural Science in Johannesburg East schools, Gauteng Province.

1.2.1 Research questions

The study investigated the following questions:

Question 1 How is the child centred approach implemented in teaching Natural Science in Johannesburg East schools?

Question 2 Which child centred teaching methods are used in teaching Natural Science in Johannesburg East schools?

Question 3 How are the child centred teaching methods used in teaching Natural Science in Johannesburg East schools?

1.3 Aim of the study

The study aimed to investigate and analyse how the child centred approach is applied in the teaching of Natural Science in Johannesburg East schools, Gauteng Province, in order to gain a deeper understanding of the child centred teaching methods and strategies currently used in teaching Natural Science learners. This made it possible to come up with suggestions and recommendations on how best a wide variety of child centred teaching methods and techniques can be used when teaching Natural Science.

1.4 Research Methodology

1.4.1 Research Design

The study used qualitative research design, because it made it easy to use observations, focus group discussions and open ended questions. This was advantageous to the study because it allowed the researcher to change the data collection strategies by adding, refining and dropping certain questions and techniques as necessary. It also allowed the researcher to present and analyse findings in a more detailed narrative form.

1.4.2 Qualitative Design

Creswell (1994) contends that qualitative research is a systematic inquiry based on interpretivism which seeks to build a holistic, largely narrative, description to inform the researcher's understanding of a social or cultural phenomenon. Qualitative research takes place in natural settings employing a combination of observations, interviews, and documents reviews. Qualitative design as earlier highlighted was used in this study due to its interactive nature which allowed for the use of open ended questions, observations and focus group discussions. This was advantageous because it allowed the researcher to change the data collection strategies by adding, refining and dropping certain techniques when necessary. This design is good when gathering data, because it relies heavily on interactive interviews. This gives an opportunity to interview participants several times in order to follow up on a particular subject, clarify concepts or to check the reliability of data. When using this design method it becomes possible to rely on multiple data collection methods to check the authenticity of results.

Rogers (2008) argues that data collection in qualitative study takes a great deal of time, because the researcher needs to record any potentially useful data thoroughly, accurately and systematically. This was not seen as a challenge in this study, but it was seen as a good opportunity, because the aim of this study was to investigate and record information about the implementation of the child centred approach in, Johannesburg East schools thoroughly, accurately and systematically.

1.4.3 Qualitative Design research methods

Rogers (2008) tabulate qualitative research methods as focus groups, observations, document analysis, and interviews. In this study observations followed by focus group discussions were used to gather data, because they were appropriate for collecting comprehensive information. Rogers (2008) asserts that focus groups generate more information, because they allow the researcher to clarify questions and probes further in order to get accurate and sufficient information from respondents. He proceeds to assert that observations give the researcher an opportunity to see the phenomenon practically, and then generate specific questions based on what was practically observed. In this study

Natural Science teachers were observed teaching in class and recordings were made, and after that focus group discussion questions were generated from what was observed.

1.5 Data collection instruments

Data was collected using observations and focus group discussions. Selected teachers were observed teaching Natural Science in class. Recordings were made on which child centred teaching methods they used and how they used them as they delivered their lessons. After observations a focus group discussion guide was developed. Most focus group discussion questions emerged from what was observed in class when teachers were teaching. The researcher led the proceedings in the focus group discussions by asking participants questions, and he recorded down their responses. Participants were given an opportunity to make comments on responses given, and to as well ask the researcher and other participants questions in order to generate more information, and to also have certain issues about the child centred approach clarified.

1.6 Sampling

Black (1999) contends that sampling is a way of choosing participants who will partake in the study, while Rogers (2008) argues that sampling is the use of the population to represent the whole population. For the purposes of feasibility and data analysis not all schools in Johannesburg East participated in this study, and also in selected schools not all NS teachers participated. Though initially convenient sampling was used to select Johannesburg East district because of its easy access to the researcher, but random sampling was convenient for the study. Random sampling was used to select five schools in Johannesburg East. Random sampling was also used to select teachers who participated in the study in selected schools. Reasons for using random sampling were that it is the most convenient method when dealing with volumes as the case was in this study, and it also gave every school and teacher an equal chance of being selected to participate in the study. This notion is supported by McMillan and Schumacher (2010) who contend that in random sampling each member of the population or of sub-group has an equal probability of being selected. Welman (2005:59) uses visual illustrations to highlight that random sampling is good when dealing with large numbers. In light of this, this method there-fore was appropriate to deal with Natural Science teachers in selected schools

As highlighted above only five schools were randomly selected to participate in the study. Selecting five schools made it feasible to deal with the selected participants from these schools thoroughly in order to get the best information for the study from them. Two NS teachers were observed teaching in class per school while three NS teachers participated in focus group discussions per school. The 2 teachers who were observed per school were selected from a team of Natural Science teachers using a random selection method. Two NS teachers per school were considered sufficient and convenient for thorough lesson observations. The 2 teachers who were observed teaching automatically became part of focus group discussions because there were questions that arose when they were being

observed that they were supposed to answer. Out of NS teachers who were not selected to partake in the study random sampling was used to select 1 teacher to join the other 2 teachers in the focus group discussions per school. This meant that focus group discussions per school were composed of 3 NS teachers. Having 3 NS teachers in focus groups was seen as essential in stimulating detailed and stimulating informative discussions that would generate sufficient information for the study. The convenient number of teachers who were observed teaching in class and those who participated in focus group discussions made it feasible and easy to conduct lesson observations and focus group discussions. All these teachers were randomly selected per school to participate in the study. Doing so gave all of them an equal opportunity of being selected to participate in the study. Selected numbers made it easy to conduct observations and focus group discussions. A focus group with three members was easy to control, and it also allowed each and every member to have adequate time to air their views and opinions about the implementation of the child centred approach in their schools.

1.7 Data analysis

Data collected from observations and focus group discussions was presented and analysed qualitatively in the form of textual narratives. In brief data in this study was presented narratively followed by discourse analysis.

1.8 Ethical considerations

Vasta (1992) contends that some types of research can have psychological or emotional effects on the participants. To avoid this, ethical issues were dealt with in this study. All participants were told the objectives and requirements of the study, so that they could decide whether to participate in the study or not. A declaration form with ethical considerations was filled by all participants. In this form participants indicated their willingness to partake in the study. They also indicated that they wanted their names to remain confidential. Due to this fact, all participants have been referred to as respondents, participants or NS teachers in this study. The names of participating schools were not disclosed as well in order to avoid controversy. They were only referred to as participating schools.

Since the design of this study is qualitative there was no danger of physical harm to participants since experiments that usually cause harm to participants were not conducted. Vigilance how-ever was exercised to maximum levels in order to avoid any lapse that would inflict psychological or emotional harm to participants during the course of the study. From the onset participants were told that they could withdraw from the study at any time if they felt like. All participants were also told right from the beginning that participation in the study was voluntary and by choice. It was also made clear to them before they started participating that, they were not going to be paid for their contributions and participation in the study. The researcher applied and was issued with the research approval letter by Gauteng Province Department of Education. This letter gave him permission to conduct a

study in Johannesburg East schools. In order to comply with ethical standards the researcher also applied for ethical clearance certificate from UNISA CEDU REC, and was issued with the Research Ethics Certificate. The researcher made sure that all participants were given a consent form with research ethical considerations to complete before they started participating in the study. Filling in and signing such a form ensured informed consent on the part of participants.

1.9 Chapter Summary

This chapter highlighted the changes of the South African curriculum from the apartheid one right up to the CAPS 2012 documents which advocate for the use of the child centred approach in education. The 1996 democratic constitution which gives all children a right to learn has also been touched. The chapter went further to trace the origin and development of the child centred approach. It emerged that the child centred approach is as old as education its-self. It can be traced to as early as 35 000 BC. It how-ever became more popular in the 20th and 21st centuries. The definition and benefits of the child centred approach were also mentioned. The child centred approach has been defined as a scenario where by the teacher plays the role of the facilitator and allows learners to play an active role during learning in class. The problem of the study was stated as well. The problem emanates from the fact that CAPS 2012, instructs Natural Science teachers to stop using boring traditional teaching methods such as rote memorisation and start using the more interesting child centred teaching methods when teaching Natural Science in class without elaborating on which methods are to be used and how they are supposed to be used, what challenges are associated with their use, and how are such challenges supposed to be dealt with. The chapter went on to highlight the questions and aim of the study. After that it elucidated that a qualitative design approach was used to collect data for the study. The qualitative design methods that were used to collect data are observations and focus group discussions. These methods were used because they allowed the researcher to observe the phenomenon practically and also engage participants on a face to face basis. The chapter ended by explaining how ethical issues were handled. It was clearly highlighted that research ethics were exercised in this study. Participants were given a consent form to fill in order to ensure that participation was consensual. They were given an option to withdraw if they felt like they were no longer interested in continuing participating in the study. To ensure higher standards of abiding to the research ethical standards a UNISA ethical clearance form was completed and submitted to CEDU REC and a Research ethical certificate was issued. Permission to conduct research in Johannesburg East schools was sought from Gauteng Department of Education, and the department issued the researcher with a Research approval letter. It was ensured that participation in this study was strictly by consent.

1.10 The next Chapter

The next chapter reviews literature in order to find out what other researchers had written about the child centred approach. Literature review made it possible to come up with a wider understanding of what the child centred approach is all about. It also made it possible to come up with benchmarks on how best the child centred approach can be implemented in teaching Natural Science in Schools.

Chapter 2: Literature Review

2.1 Introduction

In order to fully understand the child centred approach it became necessary to review the work of philosophers, psychologists and theorists who came up with the philosophical and Psychological perspectives, theories and concepts of the child centred approach. Henson (2003) asserts that empirical evidence proves that the child centred approach is as old as education its-self. This chapter investigated the origin and development of the child centred approach from two perspectives, the philosophical and psychological perspectives. On the Philosophical side, the work of great philosophers like Jean-Jacques Rousseau, Johann Pestalozzi, Friedrich Froebel, colonel Francis Parker, and John Dewey was reviewed, while on the Psychological perspective the review centred on the work of Jean Piaget and Lev Vygotsky due to the fact that these two are considered by many academics and educationists as the most prominent psychologists in education. Having highlighted Piaget and Vygotsky a cognitive and social constructivists it is imperative to state that Jonassen (1994) assert that constructivism theory suggest that learners construct knowledge out of their experience. He goes on to contend that, constructivism is associated with pedagogic approaches that promote active learning or learning by doing. A review of the work of philosophers who contributed to the child centred approach to teaching and learning right from its inception up to its growth and revolution made it possible to come up with a broader picture and full understanding of the child centred approach and how it is supposed to be implemented in the classroom. Such a review clearly revealed where the child centred approach came from, when and how it grew from strength to strength in its quest to revolutionise the education systems of the world. Reviewing the contributions to the child centred approach by great psychologists like Jean Piaget and Lev Vygotsky especially on constructivism paradigm shaded light to the study on how teachers in general and Natural Science in particular are supposed to prepare for and implement a child centred instruction when teaching Natural Science in class.

This chapter further explored various scholarly views on the child centred approach and how it is used when delivering lessons in class. The chapter also articulated different child centred teaching methods that can be used by Natural Science teachers when delivering lessons in class. Also given in the chapter is a detailed outline of a range of skills that are developed by the child centred approach. Other issues explored include the child centred curriculum, availability of resources, parents' involvement, teacher training and empowerment. For the purpose of this study the following terms were used interchangeably. These terms are, child centred approach, learner centred approach, as well as student centred approach. This has been the case because authoritative sources such as Morrison (2010), Weimer (2002), and Motschnig & Holzinger (2002) use these terms interchangeably.

2.2 The Philosophical perspective of the child centred approach.

2.2.1 Origion and development of the child centred approach.

It is attested by Henson (2003) that the signs of the learner centred education began to show right from the dawning of education, and according to him formal education can be traced back to the Sumerians and the development of written language (around 3500 BC). Within five hundred years Chinese had also established formal schools where early teachers emphasised individual character and citizenship. Seemingly the earliest individual teachers to have a profound, direct effect on the learner centred approach were the Chinese Philosopher Confucius (551 B.C-479 BC), and the Greek philosopher Socrates (460-399 B.C). Ozmon & Craver (1999:105) cited in Henson (2003) argue that Confucius stressed character and citizenship, while Socrates stressed the individual. They believed that every person must strive for the continual development of self until excellence is achieved.

The earliest known formal teaching method was the tutorial method. For five thousand years the tutorial method continued to dominate. Although the English Philosopher John Locke (1632-1704) recommended its use, he introduced the concept, tabula rasa or blank slate, meaning that at birth the child is a blank slate, and the only way to fill it is through having experiences, filling these experiences and reflecting on them Henson (2003). This proves that Locke believed that the mind gets its understanding from experience. Stimulated by Locke's philosophical assertion philosophers like Jean Jacques Rousseau, and other philosophers who were inspired by Rousseau and continued to inspire others explored the breadth and depth of the child centred approach to teaching and learning. The details of their explorations are going to be articulated below as the case has been highlighted in the introduction of this chapter.

2.2.3 Jean Jacques Rousseau.

Mark (2005) asserts that Jean Jacques Rousseau 28 June 1709- 02 July 1778 was a Genevan Philosopher, writer and composer of the 18th century. He quotes Rousseau as saying that, 'the noblest work in education is to make a reasoning man, and we expect to train a young child by making him reason! This is beginning at the end; this is making an instrument of a result. If children understood how to reason they would not need to be taught.' This quotation proves that Rousseau right from the beginning believed that meaningful education should make the learner to reason and to be creative, otherwise if education fails to achieve this it ceases to be relevant to learners.

It is also imperative to state that according to Mark's (2005) assertion child centred education is traced to Jean Jacques Rousseau (1778) whose Philosophy of education is not concerned with particular techniques of imparting information and concepts, but rather with developing the learner's character and moral sense, so that he may learn to practice self-mastery and remain virtuous even in the unnatural and imperfect society in which he will have to live. Rousseau sees education as a tool that is used to acquire survival skills and competencies through reasoning and creativity. This is illustrated when a hypothetical boy

Emile is to be raised in the country side, which Rousseau believes is a more natural and healthy environment than the city, under the guardianship of a tutor who will guide him through various learning experiences arranged by the tutor. The tutor will make sure that no harm results to Emile through his learning experiences. Like modern behaviourist Psychologists Rousseau believed that the child learns through consequences rather than through physical punishment.

Lynda (2002) contends that Rousseau was one of the first to advocate developmentally appropriate education, and his description of the stages of child development mirrors his conception of the evolution of culture. He divides childhood into stages.

- **First stage** age 12, when children are guided by emotions and impulses.
- **Second stage** 12-16 years, reason starts to develop.
- **Third stage** 16 years on wards, when the child develops into an adult.

Rousseau recommends that the young adult learns a manual skill such as carpentry which requires creativity and thought. His philosophy pays more emphasis on producing a creative learner who is able to reason on his own and solve problems, as opposed to producing a passive learner who is accustomed to a dependence syndrome always.

Vincent (2009) attests that the Swiss born Jean Jacques Rousseau in his book Emile Rousseau recommended a type of education that was unknown at the time, an education that was natural, child centred, and experience based. His main intent was to protect children from a corrupting society and allow them to develop naturally. This was demonstrated by the fact that Emile was given the freedom to explore and interact with nature. When Emile behaved inappropriately his punishment was administered not by his tutor. On one occasion, Emile broke the window pane in his bedroom. Instead of giving him a whipping, which was the common response to misbehaviour, Rousseau ignored the event and let him experience the resulting cold wind and rain. This is a good philosophy that still applies up to date. Children learn better on their own from consequences that they generate for them-selves. This philosophy as well is in line with behaviourism perspective which contends that the behaviour of children is shaped by consequences, because children continue with the behaviour that result in positive consequences, but tend to stop or discontinue the behaviour that result in negative consequences as the case is in Thorndike's cage and Skinner's box. In the same token Natural Science learners need to be actively involved during the lesson in order to enable them to achieve and enjoy the results of their own effort. Once this happens these learners will be motivated and continue working hard on their own and in groups so that they continue reaping positive results of their own hard work and initiative.

2.2.4 Johann Heinrich Pestalozzi

Bruhlmeier (2010) accentuates that Johann Heinrich Pestalozzi (January 12, 1746-February 17, 1827) was a Swiss pedagogue a social education reformer who exemplified Romanticism

in his approach. He founded several educational institutions both in German and French speaking regions of Switzerland, and wrote many books explaining his revolutionary modern principles of education. His motto 'learning by head, hand and heart' is still the key principle in successful 21st century schools. Silber (1965) argues that due to Pestalozzi's contributions in education illiteracy in 18th century Switzerland was overcome almost completely by 1830. Due to his immense contributions in education he was known as the father of modern education. Pestalozzi's pedagogical doctrines are highlighted by Silber (1965) as stressing that instruction should proceed from the familiar to the new, incorporate the performance of concrete arts and the experience of actual emotional response and be paced to follow the gradual unfolding of the child's development.

Silber (1965) also contends that when the French army invaded the town of Stans in 1798 many children were left without a home or family. The Swiss government established an orphanage and recruited Pestalozzi on December 5, 1798 to take charge of the newly formed institution. This according to Silber (1965) was a dream come true to Pestalozzi, because this appointment gave him an opportunity to bring vast reforms in the education system of the day by introducing the education system that served the interests of the learners. This type of education according to Bruhlmeier (2010) was to be later called the child centred education.

2.2.5 Pestalozzi's ideas in Education

Bruhlmeier (2010) stresses the fact that Pestalozzi's educational methods were child centred and based on individual differences, sense perception, and the student's self-activity. Bruhlmeier (2010) continues to attest that in 1819 Stephan Ludwig Roth came to study with Pestalozzi, and his new humanism contributed to development of the method of language teaching, including considerations such as the function of mother tongue in the teaching of ancient languages. Pestalozzi and Niederer were important influences on the theory of Physical education. They developed a regimen of physical exercises and outdoor activities linked to general, moral and intellectual education that reflected Pestalozzi's ideal of harmony and human autonomy. These activities that these two Philosophers developed are of paramount importance in today's schools, because they involve, engage and motivate learners. Learners when carrying out these activities are entertained and educated at the same time, while on the other hand learners are being prepared for autonomy in life.

Pestalozzi's principles of education especially the development of the whole person through child centred teaching methods inspired many in education up to date. Philosophers like Froebel and Parker were inspired by Pestalozzi's work Lilley (1967). Watson (1997) asserts that most education systems nowadays have either implemented or are in the process of implementing the child centred approaches that would produce a holistic learner who will become a useful member of the society. The principles of the child centred approach were further promoted and consolidated by Philosophers like Pestalozzi and others. Bruhlmeier

(2010) in line with the above notion argues that Pestalozzi's approach has had massive influence and relevance on education, for example:

- The influence on the needs of the child.
- A child centred rather than a teacher centred approach to teaching.
- Active rather than passive participation in the learning experience.
- The freedom of the child based on his/her natural development balanced with the self-discipline to function well as an individual and in society.
- The child's direct experience of the world and the use of natural objects in teaching.
- The use of the sense of training pupils in observations and judgement. In Natural Science learning can only be meaningful if learners are given an opportunity to observe a phenomenon like a crater and then come up with their judgements about the formation of that particular crater based on their observations and previous knowledge.
- Co-operation between the school and the home, and between parents and teachers. Parents' involvement is very important in the modern child centred education system. However educationists, researchers and academics should carry out a thorough research and come up with recommendations and a criteria on how parents are supposed to be involved in a meaningful manner, because if such a criteria does not exist parents involvement can be interference and unproductive.
- The importance of all round education, which is the education of the head, the heart and the hands, which is led by the heart. This is in line with Bloom's Taxonomy that calls for the integration of the cognitive domain, affective domain as well as the psycho-motor domain.
- The use of the systematised subjects of instruction, which are also carefully graduated and illustrated.
- Learning which is cross curricular and includes a varied school life.
- Education which puts emphasis on how things are taught as well as what is taught.
- Authority based on love not fear.
- Teacher training. In order to implement the child centred teaching methods it is imperative to invest a lot of resources in proper teacher training and development.

Pestalozzi's influence over the spirit, the methods and the theory of education has continued into the twentieth and twenty first centuries, and most of his principles have been assimilated into the modern system of education, and are highly relevant to the teaching of Natural Science where learners need to be supported by their parents in as far as scientific equipment and field tours are concerned. In such cases teachers and parents need to work as a team for the good of the child. Important of all is round education and learning which is cross functional, capable of linking Natural Science with Geography, Tourism, Life Orientation and History to mention but just a few. This linkage helps learners to have a broader picture of education, and to appreciate the fact that all subjects are linked

and they are all equally important in their success at school. It also sheds light to them that subjects cannot be learnt in isolation, but they are supposed to be learnt as a total whole in the school curriculum.

2.2.6 Friedrich Froebel

Friedrich Froebel was born on the 21st of April (1782) in Oberweisbach, Germany. Watson (1997) asserts that Froebel started his career in the forestry industry where he studied botany and biology, but later ended up teaching in a primary school. It was his study of and love of nature that influenced his views on the importance of nurturing children. He enjoyed working with children so much that he decided to make education his life long career. His programme intended for the child to be free, creative spirit within the classroom where one can grow and express themselves as God intended. He believed that this process should begin at a very young age. Lilley (1967) describes some components of Froebel's Kindergarten Philosophy as follows:

- a. Humans are creative beings.** Under this tenet Froebel is of the opinion that what separates humans from other life forms is that they can alter their environment, because human brains allow humans to visualise, and imagine a different future. It is in light of this that Froebel attests that, true education must help children to understand their true nature as creative beings. In the same token Natural Science education in particular as a Science subject should be delivered in a way that would enable learners to understand their nature and also understand that they are creative beings who can positively transform families and communities through their creativity.
- b. Play is the engine that drives true learning.**

Lilley (1967) highlights Froebel as attesting that, play is not idle behaviour, it is a biological imperative to discover how things work. It is happy work, but definitely purposeful. Natural Science can be more enjoyable if certain educational games are introduced. Guido (2005) argues that Children enjoy playing while at the same time learning something. He goes on to assert that the 21st century presents a big opportunity of introducing carefully chosen scientific videos and scientific games that can help learners acquire scientific knowledge and skills better, while at the same time having joy and fun.

2.2.7 Colonel Francis Parker.

Henson (2003) asserts that American educators became serious about the child centred approach at the end of the civil war, when a soldier and teacher named Colonel Francis Parker returned to his home state of New Hampshire where in 1865 he accepted principal ship in Manchester. Three years later in 1868 unhappy with the rote memorisation that characterised schools at that time, Parker accepted principal ship in Dayton, Ohio, where he headed the first normal school, giving demonstration lessons to help teachers learn how to use the child centred teaching methods. Frustrated by the American's slow embracing of the child centred approach, Parker went to Europe in Berlin to pursue an academic degree,

because he got information that Europe was far ahead of America in the implementation of the child centred education. His main goal was to learn directly from the Europeans about their learner centred education.

Campbell (1967:99) cited in Henson (2003) attests that on his return to the US in (1875) Parker accepted Superintendence position in Quincy, Massachusetts, where he gave model learner centred lessons in all seven Quincy schools. He also held district wide teachers' meetings where he demonstrated learner centred techniques to teachers. By replacing drill with inquiry activities, Parker replaced memorisation of facts with understanding. It has to be stated how-ever that some of the sections of the American society criticised Parker's new approach to reform the deplorable American education system. Such criticism how-ever instead of having a negative impact managed to have a positive impact by making Parker's learner centred approach to education more popular in American schools. In the time of his death in 1902 Parker's learner centred approach to education was adopted by many schools, and had a lot of followers in the US. Seemingly this was the beginning of the new revolution in education not only within the boundaries of USA but beyond to other territories of the world, because in the 21st century according to Henson (2003) many countries are dropping rote learning and embracing the child centred approach to learning. Sparrow's (2000) attests that the only concern about the child centred approach is whether countries are implementing it correctly, because the correctness of the implementation of the child centred approach is of great interest to many education systems of the world.

2.2.8 John Dewey.

Henson (2003), Guido (2005) accentuate that John Dewey (1859-1952) used his very long life to exert more influence on education and philosophy than any other American before or and thereafter. They contend that Dewey was influenced by Locke's tabula rasa, Bacon's scientific method, Immanuel Kant's pragmatism, the idea that philosophy is only valuable if one can apply it, Charles Pierce's (1839-1914) insistence on the clarification of ideas and his belief that one's mental grasp of any idea depends on the unification of the idea in actual experience, and William James' (1842-1910) beliefs that truth is inseparable from experience, and that experience like life its-self is a stream of sequential events.

Guido (2005) goes on to highlight Dewey as attesting that, occasionally children need to be alone on their own. They learn more by doing things together and in groups, planning their work, helping one another to do it, trying out various ways and means of performing the task involved, discovering what will forward the project, comparing and appraising the results. By doing this learners would best develop their latent powers, their skills, understanding, self-reliance and co-operative habits. Dewey believed that the questions and answers arising from such joint enterprises would expand the child's horizons by linking his immediate activities with the larger life of the community. He highlighted that young children aged 6 or 7 who take up weaving, for example, can be stimulated to inquire into the cultivation of cotton, its processes of manufacture, the history of spinning devices. Such

lines of inquiry emerging from their own interests would open windows upon the past, introduce them naturally to History, Geography, Science and Technology. This will establish vivid connections between what they are doing at school and the basic activities of human existence.

The assertion above is in line with Sparrow's (2000) opinion, where he argues that participation in meaningful projects, learning by doing, encouraging problems and solving them, not only facilitates the acquisition and retention of knowledge, but it fosters the right characteristics traits, unselfishness, helpfulness, critical intelligence, as well as individual initiative. He says that this is the case because learning is more than assimilating; it is the development of habits which enables the growing person to deal effectively and most intelligently with his environment, and where that environment is in rapid flux, as in modern society, the elasticity which promotes readjustment to what is new is very essential.

2.3 Psychological Perspective on the child centred approach.

As previously discussed the philosophers mentioned above really focused on the learner centred approach to education, and some of them highlighted the types of conditions that are necessary in schools for meaningful learning to take place. It has to be noted how-ever that these were philosophers. Philosophers are good in coming up with ideologies and lines of thought. They can't direct or prescribe behaviour. In light of this though the philosophical ideologies discussed above are all relevant to the teaching and learning of Natural Science as a subject, it is imperative to use them collaboratively with psychological perspectives and theories. This means that a balanced investigation of the learner centred approach to teaching and learning should also examine Psychologists' views about the child centred approach. Jadallah (2000), Weimer (2002) argue that psychologists' perspectives are very important when it comes to the practical implementation of the child centred approach, because psychologists prescribe and as well suggest what ought to be done in order to successfully implement the child centred approach to teaching and learning. From the 20th up to the 21st century according to Jadallah (2000) wholesale psychological developments influenced the development of the learner centred approach to teaching and learning. Worth mentioning were the development of constructivism ideology, dispositions and perceptual Psychology.

2.3.1 Constructivism and the child centred approach.

According to Jadallah (2000) pedagogically, the learner or child centred approaches to teaching have emerged from changing understanding of the nature of learning, and in particular from the body of learning theory known as constructivism. Hein (1991) accentuates that in the broadest terms, constructivist learning is based on an understanding that learners construct knowledge for them-selves. Duffy & Jonassen (1998) argue that the learner is not a blank slate, but brings past experiences and cultural factors to a situation. In light of this they contend that the constructivist teacher provide tools such as problem

solving and inquiry based learning activities which learners formulate and test their ideas, draw conclusions, inferences, pool and convey their knowledge in a collaborative learning environment. These authorities proceed to allude that constructivism transforms the learner from a passive recipient of information in class to an active participant in class during the learning process. Always guided by the teacher students construct their knowledge actively rather than mechanically ingesting knowledge from the teacher or the text book. Hein (1991) on the other hand is of the opinion that constructivist theories encompass a disparate array of Philosophical, Psychological, and epistemological orientations. Jadallah (2000) on the other hand asserts that cognitive constructivism is based on Piaget's model which emphasises the interaction between the individual and their environment in constructing meaningful knowledge, while on the other hand social constructivism is attributed to the work of Vygotsky, and it emphasises the importance of student learning through interaction with the teacher and other students. Weimer (2002) contends that, the principal implication of constructivist understanding for the way in which knowledge is produced is that students are the key initiators and architects of their own learning and knowledge making, rather than passive vessels who receive the transmission of knowledge from expert teachers. This approach ultimately holds students responsible for their own learning.

Weimer (2002) continues to assert that constructivists identify learner centred teaching as encompassing five changes in practice:

- Shifting the balance of classroom power from teachers to students.
- Designing content as a means to building knowledge rather than a knowledge end in its-self.
- Positioning the teacher as the facilitator and contributor, rather than director and source of knowledge.
- Shifting responsibility for learning from teacher to learner.
- Promoting learning through effective assessment.

The points highlighted above mean that moving towards a learner centred approach entails changing the learning environment and responsibilities of teachers and learners, changing the communication of the learning content, as well as changing the assessment to learning.

On the other hand Sparrow (2000) argues that constructivism is divided into two groups. One group focuses on the interaction amongst learners while the other focuses on each learner's perceptions. Jadallah (2000) attests that during the twentieth century Lev Vygotsky (1896-1934) carried out a study of the learners' interaction, and he realised that when learners solved problems by discussing them as a group they managed to discuss until they came up with solutions to those types of problems. This means that learners effectively come up with proper solutions to problems if they work as a group than when they work as individuals. This is important in Natural Science when learners are collecting living and non-

living organisms during the field tour. They can manage to come up with meaningful collections if they work as a team, than when working as individuals. Learners can also manage to conduct experiments successfully in the laboratory if they use the collaborative approach that enables them to assist and complement each other's efforts, than when they work individually.

Henson (2003) is of the opinion that Vygotsky used a system, which is now known as co-operative learning to encourage co-operation with each learning group. Members of the group have to help each other if they are to achieve intended goals. Learners in a group have to work as a team and succeed as a team. The teacher can only guide learners as they work through the tasks in their groups. Henson (2003) says that the teacher must not interfere too much in group activities, but he must only give them guidance and allow learners to learn from each other. Donald (2008) argues that learners learn better from each other, and when they do things them-selves on their own in groups. In brief according to Donald (2008) if learners work collaboratively as a group, unproductive competition that is usually rife in classrooms is automatically replaced by productive co-operation among learners in the classroom.

Weimer (2002) contends that another leading Psychologist who contributed positively to constructivism was Jean Piaget. Jean Piaget was a Swiss Psychologist born in 1896, the same year that the Russian Lev Vygotsky was born. Piaget focused on the learner as an individual. His four staged cognitive development theory is the most popular one in education up to date. Piaget believed that the child's cognitive development progresses through the four stages, sensorimotor stage, Pre-operational stage, concrete operational, and formal operational stage. Piaget according to Watson (1997) believed that in order for the child to be able to develop concepts and progress from one stage to another they need to be exposed to problems. Problems are the ones that make them to be creative thinkers. His third stage the concrete operational stage shows that in class learners should be given concrete problems that would allow them to manipulate and come up with solutions. This means that Natural Science teachers should use problem solving methods when teaching in order to involve learners and enable them to think creatively. This is the case because Watson (1997) says that problem solving develops and improves learners' creativity and, it also equips learners with problem solving skills that are not only necessary in schools, but in communities as well.

2.3.2 Perception and the child centred approach to teaching and learning.

Perception plays a pivotal role in the child centred approach to teaching and learning. Brookfield (1990) attests that in the mid-twentieth century Psychologists through research found out that perception shapes what kind of people learners will become.

Combs (1962) cited in Henson (2003) attests that learner-centred teachers can nature the development of learners' positive self-concept by, assigning to learners problems that are challenging but are within their capabilities, encouraging learners to succeed, and if learners

succeed, teachers have to recognise these successes in order to encourage learners to continue working hard and aiming for success.

Kelly (1962) cited in Brookfield (1990) is of the opinion that, the growing self must feel that it is involved, and that it is really part of what is going on. This assertion echo the very nature of learner centred education. It clearly highlights the need to put the learner at the centre of learning and in an active role. When learners are involved in the activities that nature their development they become motivated and eager to learn more Combs cited by Henson (2002). The learner centred approach is an excellent tool of developing a useful and creative citizen for the future, who will promote development and freedom in the society Combs cited by Henson (2002).

2.3.3 Dispositions and the learner centred approach

Garforth (1964) cited in the Citedal (2002) argues that there are several important dispositions that are of paramount importance to the child centred approach. These dispositions are listed as follows:

- Education should be experience based.
- Learners' distinct dispositions and characteristics should be taken into consideration when teachers are planning for lessons.
- The curriculum should be shaped by learners' perceptions.
- Teachers should nature learners' curiosity.
- Learning takes place well when emotions are involved.
- The learning environment should be free from fear and harm.

The information from philosophers and psychologists given above proves that the child centred approach to teaching and learning originated long ago from time immemorial, and it has been developing over the past centuries. It is also imperative to state that Philosophers like Rousseau, Pestalozzi, Parker and others formed a solid foundation for the child centred approach, because their Philosophical and conceptual framework of the child centred approach still continues to influence the education system of the day in many countries including South Africa.

2.4 The child centred approach

Many researchers such as Weimer (2002), McCombs (1997), Dewey (1998), and Erickson (2007) and others over the past years have carried out research about the child centred approach to teaching and learning. Their findings and contributions are of interest and relevance to the study.

The child centred approach according to Weimer (2002) is an approach to teaching and learning that has been so popular in the 20th and 21stcenturies. He goes on to say that the main idea of this approach is to involve learners during the learning process as opposed to having the teacher dominating the whole learning process, with learners playing a passive

role as if the teacher is a fountain of knowledge and learners are empty vessels that need to be filled in with information. In South Africa the National Curriculum and Assessment Policy Statement CAPS (2012) for Natural Science Grade 7-9 is based among others on the following principles (c) 1. **Active and critical learning:** encouraging an active and critical approach to learning, rather than rote and uncritical learning of given truths. This reveals that the South African education as highlighted by CAPS (2012) Documents that are manuals of operation in Education according to the Department of Education (2011) requires learners to take a focal point in their own learning in class.

The child centred approach is also defined by Mayer (1998) cited in Barbara (2007) as a learning process whereby learners work individually or in small groups to explore, investigate, and solve authentic problems and become actively engaged in seeking knowledge and information rather than being passive recipients. She continues to assert that, in traditional learning mode, the teacher basically controls the instructional process. The content is delivered to the entire class, and the teacher tends to emphasise factual knowledge, and the focus of learning is on the content, that is how much material has been delivered, and how much have students learnt. This shows that this traditional rote memorisation learning mode tends to be passive and learners play little part in the learning process. Contrary to what takes place in the traditional teaching and learning approach where Donald (2008) attests that teaching is concerned with the teacher being the controller of learning environment, and plays the role of instructor and decision maker with regards to curriculum content, specific outcomes and teaching methods, Mayer (1998) cited in Barbara (2007) assert that in the learner centred approach, learners play an active part in the learning process. They become autonomous learners who are actively engaged in constructing meaning within the context of their knowledge, experiences and social environments. He continues to say that learners become successful in constructing knowledge through solving problems that are realistic, and they usually excel when they work collaboratively with others. All this means that the child centred approach is learner centred as opposed to teacher domination. This is in line with Weimer (2002), Cheryl (2004) and Kember & David (2009) who argue that, the learner centred paradigm departs from traditional teaching models by focusing on learners more than teachers, and learning more than teaching. Cheryl (2004) goes on to say that, learner centred teaching represents a paradigm shift from traditional teaching methods by focusing on how students learn instead of how teachers teach. In light of this according to Cheryl (2004) teachers should therefore ask themselves the following fundamental questions: How can I improve my students' learning? Instead of asking themselves how can I improve my teaching? This should be the case because in the child centred approach what matters is how much have students learnt, as opposed to how much has the teacher taught? The teacher according to Pederson (2003) can teach through wrong methods for some hours and learners can still fail to grasp or to understand concepts being taught. Pederson (2003) goes on to suggest that the teacher has to be concerned about whether learners managed to grasp concepts than being concerned

about how much chunks of information he/she has delivered in class. In the quest of clearly highlighting what the child centred approach is all about Newble (1995) outlines the premises of the learner centred teaching. In the outline of his premises he argues that in implementing the child centred approach teachers should:

- Assume that students are capable learners who will blossom as power shifts to a more egalitarian classroom.
- Use content not as a collection of isolated facts, but as a way for learners to critically think about the big question in the field.
- Change the role of teachers from sole authoritarian to fellow travellers in search of knowledge.
- Return the responsibility of learning to learners themselves so that they can understand their learning strengths and weaknesses, and feel self-directed in their knowledge quest.
- Utilise assessment measures not just to assign grades, but as the most effective tool that promotes learning. This means that assessments promote learning through giving comprehensive feedback.

This paradigm shift from the traditional approach to the child centred approach means that teachers become core-learners with students, thus in the process eliminates the distinction that has existed for a long time between these two groups Newble (1995). From the above assertions it can be said that in the child centred approach, learners are involved, and they play an active role rather than a passive one during the learning process. It can also be argued that the traditional rote memorisation mode of teaching is replaced by a more interactive approach where learners do things on their own and come up with new information and discoveries. This is in line with Chan (2009) who asserts that, instead of taking a centre stage and a dominating role during the lesson the teacher takes the role of a facilitator. Smith (2003) is of the opinion that the teacher guides and directs the lesson, and let learners take the centre stage during the learning process. Smith (2003) continues to assert that in order for all this to succeed the teacher must accept reality that learners are not empty vessels that need filling, but they are knowledgeable and creative thinkers who have rich information that is valuable for the lesson. The teacher must also appreciate that he is not the only fountain of knowledge in class, but learners also have valuable knowledge that they can share with each other. Donald (2008) argues that nowadays the world is experiencing the revolution in Information and Communication Technology (ICT), Learners there-fore through this ICT revolution are better positioned to go and research on their own and bring a wealth of scientific knowledge in class that they can share with others. In the child centred approach lessons the teacher gives learners a chance to share such information. Doing so according to Donald (2008), Chan (2009) motivates learners, and enables them to understand concepts better while enjoying the lesson at the same time.

2.4.1 The role of the teacher in the child centred approach.

Chan (2009) argues that, in the child centred approach the teacher assumes the role of the facilitator in class. This means that the teacher's role is not to dominate learning in class, but he has to guide and direct learning. Doing so allows learners to be more involved and do the rest. This assertion is in line with Weimer's (2002) assertion, where he contends that in the child centred teaching approach, the role of the teacher is similar to that of a guide, facilitator or coach. He proceeds to assert that it has to be how-ever stated that on the surface, the learner centred approach may seem to simplify the roles and responsibilities of teachers, but it actually requires teachers to put more effort and work. As the approach focuses on learners and what they are doing, teachers have to put more time and effort in designing instructional activities and assignments that are to become vehicles through which learning occurs. Weimer (2002) continues to attest that, teachers also have to organise learning content, generate examples and craft questions. They have to create and maintain classroom conditions that are conducive for the child centred teaching methods and activities.

Blumberg (2005) accentuates that when using the child centred approach, the teacher has a role to create an environment that:

- Fosters student learning.
- Accommodate different learning styles.
- Motivates students to accept responsibility for learning, and as well inspire and encourage student ownership of learning.

Blumberg (2005) continues to argue that in a child centred approach the teacher also has a responsibility to:

- Explicitly align learning objectives, teaching methods and assessments.
- Design activities in which student interact with the material, the teacher and each other.
- Utilise multiple teaching techniques as appropriate for student learning goals.

In a child centred teaching approach the teacher does not sit back and leave learners alone, but he has a lot of roles to play if child centred teaching methods are to succeed. The teacher has to see to it that the lesson is well planned for, all or the majority of needed materials and resources are available Blumberg (2005).

Hadson (2008) argues that the new roles assigned to teachers in the child centred approach require teachers to develop certain skills that would enable them to be effective in the implementation of the child centred teaching methods. Hadson (2008) proceeds to argue that, teachers need skills that would make it possible for them to:

- Give useful practical examples during the lesson.

- Improvise where there are shortages of resources and materials. For example in Natural Science when there is no proper laboratory, no adequate apparatus and chemicals, the teacher has to improvise and make the lesson a success.
- Monitor and assess learners' work.
- Give learners constructive feedback after assessing their work, because feedback is of paramount importance in the child centred approach due to the fact that learners learn from it and be able to correct their mistakes and improve when they are given next tasks.
- Cope with learners who have different learning needs and styles. Hadson (2008) is of the opinion that, the teacher has to make sure he creates a learning environment that is conducive for all learners despite their different learning abilities and backgrounds. This can be made possible by preparing tasks and activities that accommodate different abilities of learners. These activities and tasks must range from low order to high order in order to accommodate and involve every learner during the learning process.
- Create their own teaching material. Fry, Ketteridge & Marshall (1999) believe that if teachers develop the skills of creating their own material they become effective implementers of the child centred teaching approach, because learning materials are the ones that stimulate learners to participate in an active manner in class. Teachers there-fore must not fold their hands and wait for the school to provide them with materials and equipment, because in most cases schools are ill equipped, so teachers have to use their creative skills and produce their own learning material that would involve and motivate learners in class. If the teacher has good interpersonal and public relations skills, he/she can go an extra mile and approach the community as well as the corporate world for assistance. In Natural Science for example the teacher can approach the corporate world in order to be assisted with chemicals and apparatus that are used during scientific experiments. Companies can also co-operate during educational trips and allow learners to tour their premises in order to physically experience scientific activities such as electricity generation, coal mining and the like.

In a child centred teaching approach Fry, Ketteridge & Marshall (1999) are of the opinion that the teacher has a vital role. His role ranges from preparing an inspiring and motivating lesson, assessing learners' work and giving them constructive feedback, right up to sourcing relevant resources and materials that will make the lesson more interactive, meaningful and a success.

2.4.2 The role of the learner in the child centred approach.

In the child centred approach, according to Hadson (2008) learners have a great role to take full responsibility of their learning by taking the centre stage during the lesson. The teacher is supposed to tell learners to investigate certain topics, so that during the lesson they

become active participants who play a vital role than being passive listeners who always wait to be spoon fed by the teacher. McInnis (2000) argues that in a child centred scenario learners cease to be notes takers as the case is in a traditional approach. Instead they take control and full responsibility of their learning in class. McInnis (2000) proceeds to assert that, in the child centred approach learners take a centre stage by carrying out research, writing their own notes, and going further to make presentations and demonstrations in class. Learners are also seen by him as having a responsibility of studying on their own, in pairs and groups in their homes and libraries. They are not supposed to wait for the teacher to spoon feed them, but they are supposed to study on their own and come to the teacher only for guidance and consultations. Doing so grooms learners to be responsible future adults at work places and in their communities.

Morrison (2010) contends that in a child centred learning the focus is on each student's interests, abilities and learning styles, placing the teacher as a facilitator of learning. This classroom learning method acknowledges student voice as central to the learning experience for every learner, and differs from many other learning methods like traditional ones where the teacher dominates the whole lesson in class. In a child centred classroom according to Morrison (2010) students choose what they will learn, how they will learn, and how they will assess their own learning. This is opposed to the teacher centred classroom where the teacher chooses what the students will learn, how the students will learn, and how the students will be assessed on their learning. Morrison (2010) goes on to assert that the child centred learning requires students to be active and responsible participants in their own learning. The above notion is supported by Armstrong (2012) who attests that, in traditional education methodologies, teachers direct the learning process and students assume a receptive role in their education, because traditional education ignores or suppresses learner responsibility. Contrary to this Armstrong (2012) argues that, with the advent of progressive education in the 19th century, and the influence of psychologists such as Vygotsky and Piaget the traditional curriculum approaches have been replaced with hands-on activities and group work, in which students determine on their own what they want to do in class. Key among these changes is the premise that students actively construct their own learning Armstrong (2014).

On the other hand Jaques (2000) highlights that in a child centred classroom students:

- Take responsibility for learning.
- Are active knowledge seekers.
- Construct knowledge by interacting both with his/her teachers and the data gathered through different sources, with the purpose in mind of solving a problem/task that they have been given.
- Work at stations with access to multiple resources.
- Work individually at times but often also need to collaborate in small groups under the teacher's supervision.

- Are not considered to be empty vessels. They come with their own perceptual frameworks.
- Construct their own meaning by talking, listening, writing, reading, and reflecting on content, ideas, issues and concerns.

2.4.3 Parents' involvement in the child centred approach.

Lemmer and Van Wyk (2010) contend that extensive research has shown that schooling alone cannot provide all learners with the personal and cultural competencies necessary for success. For learners to be successful, schools need the involvement of parents in children's education. They continue to argue that when schools work together with families to support learning, children tend to succeed not just in school, but throughout life. Heberman (1992), Henderson and Mapp (2000) cited in Lemmer and Van Wyk (2010) are of the opinion that, parents involvement result in decreased truancy, improved attitudes of learners to their studies, improved behaviour and a decrease in dropout rate. This is the case because children learn best when they benefit from good teaching and a supportive home environment. Parents' involvement also helps parents to understand and gain confidence on what is happening at school. This assertion is supported by Peters (2008) who contends that learners who enjoy parental support tend to be motivated and participative in class. This shows that in Natural Science the implementation of the child centred approach can become effective if parents become involved and supportive. This would be the case because Epstein (2002) asserts that if parents are involved they tend to buy learners equipment and materials. In Natural Science these may range from buying learners text books, note books, laptops, scientific calculators and dictionaries. Parents can also take their children to scientific museums, zoos, monuments, craters, and planetariums, as well as other scientific areas of interest. Doing so would inform and enlighten learners about scientific activities. If learners are more enlightened and exposed to more scientific knowledge and information, they tend to be more involved and participative in class during lessons.

Peters (2008) contends that, parents can help supervise children's work at home. They can also guide children on how to conduct research. He goes on to say that the School Development Committee (SDC) can help the school to raise money to build laboratories, libraries, classrooms, as well as to buy apparatus and chemicals for Science subjects. The SDC according to him can also encourage parents to sponsor their children's educational trips. If parents give all this support it becomes easy to implement the child centred teaching methods in class when teaching Natural Science, because children will have something to say in class after an educational trip such as visiting a crater or any other place that is of scientific interest. Peters (2008) also highlights an important issue pertaining to parents' involvement in schools. He asserts that parents' interference must not be confused with parents' involvement. He proceeds to assert that the SDC needs to educate parents about how they are supposed to be productively involved in schools so that they wouldn't interfere in the name of involvement. Parents' interference according to Peters (2008) is

dangerous because it inhibits or totally hinders the implementation of the child centred approach in schools. He however sees informed and positive parents involvement as enhancing the implementation of the child centred approach in schools, because parents tend to be a stimulating factor that provides motivation, assistance, resources and materials that are needed in the implementation of the child centred approach for example in Natural Science classes.

In light of above arguments it is imperative to state that we cannot talk about the child centred approach without mentioning that parents are an important stakeholder, and they play a vital role in the implementation of the child centred approach in Natural Science by providing the vital resources and support that is essential for the successful implementation of the child centred approach in teaching Natural Science.

2.5 Benefits of the child centred approach.

MacCombs & Whistler (1997) attest that the use of the child centred approach to teaching and learning in classrooms and schools seems to be reflective of the 21st century ideologies in communities where choice, freedom and democracy are considered to be central elements to the well-being and prosperity of these communities. They go on to say that research has proven that the child centred approach has tremendous results. MacCombs & Whistler (1997) argue that the child centred approach:

2.5.1 Develops learners' thinking skills

Problem solving approach employed in the child centred approach teaching methods according to MacCombs & Whistler (1997) teaches learners to consider multiple perspectives on a given situation or phenomenon. This develops flexibility in thinking and reasoning skills, as students compare and contrast various possibilities in order to draw their conclusions. In this scenario learners tap into their prior knowledge and experience as they attempt to solve a problem. Doing so enables learners to continually integrate new knowledge into existing knowledge. This therefore enables learners to be able to solve even more complex problems. MacCombs & Whistler (1997) also assert that through the above mentioned technique learners also learn to make connections and associations by relating the subject matter to their own life experiences. This is true especially in Natural Science subjects such as, Teaching Science Environment and Society. When teaching this subject learner can relate the following topics to their life experiences in societies. These topics are HIV/AIDS, Saving water and Electricity, Preserving and protecting the environment. These topics can be related by learners to their day to day activities in their lives in communities. On the other hand Sparrows (2000) argues that the child centred approach enables learners to learn to question ideas and knowledge through the process of comparing and contrasting alternative ideas and contexts. In Natural Science for example learners can be asked by the teacher to compare and contract indigenous and Western knowledge, and then draw up their own conclusions about the facts and worth of these two sets of knowledge based on their analysis, synthesis and evaluation. Sparrows (2000)

continues to argue that in the child centred approach learners are encouraged to engage in individual reflection in order to organise and understand the words. They experience insight as they think through a problem or inquiry activity, and draw inferences that allow them to go beyond the simple acquisition of facts and information by learning how to see implications and apply them to other situations. This therefore helps them to fit in their communities and the world of work.

2.5.2 Develops communication and social skills

According to MacCombs &Whistler (1997) through the use of the child centred teaching methods students learn how to clearly articulate their ideas, as well as to collaborate on tasks effectively by sharing project tasks as a group. This allows them to communicate and share ideas, and as well learn to negotiate with others and to evaluate their contributions in a socially acceptable manner. This is essential to success in the real world, since learners will always be exposed to a variety of experiences in which they will have to negotiate and share ideas with others in life. Prosser & Trigwell (1999) contend that developmental programmes in communities are better done through team work. They go on to argue that even at work places nowadays employers prefer people who can work and interact with others in groups and teams that are formed at work places. On the other hand Marton & Booth (1997) argue that the child centred approach through group discussions equips learners with communication and Public Relations knowledge and skills that are needed in communities and work places. Children who possess good communication and Public Relations skills fit better in societies and work places Marton & Booth (1999).

2.5.3 Encourage alternative methods of assessment.

MacCombs &Whistler (1997) assert that traditional assessment is based on an open and paper test where learners demonstrate or reproduce knowledge in the form of short responses and multiple choice types of questions that inspire little personal engagement. Contrary to this according to MacCombs &Whistler (1997) the child centred approach assessments engage the learners' intuitive and personal investment through portfolios, research reports, physical models, and artistic representations. Engaging the creative instincts develops learners' ability to express knowledge through several ways. Learners are also more likely to retain and transfer the new knowledge to real life. Douglas & Jaquith (2009) contend that one of the most critical differences between student-centred learning and teacher-centred learning is in assessment. In student centred learning students participate in the evaluation of their learning. Involvement of students in the assessment of their work motivates students Douglas & Jaquith (2009).

2.5.4 Helps students transfer skills to the real world.

According to MacCombs &Whistler (1997) the child centred approach to teaching and learning enables learners to adapt learning to the real world. Learners also through this approach gain problem solving skills and the ability to do a critical analysis of a given set of data. These skills according to MacCombs &Whistler (1997) enable learners to adapt to a

constantly changing real world environment. This therefore means that classroom learning does not result only in the acquisition of absolute truths, but it also result in a resource of personal knowledge that will help the learner to navigate through the challenges of life after completing their studies at school. On the other hand Pederson (2003) says that the child centred teaching methods equips learners with skills and knowledge that is needed in real life in communities and places of work. Denig (2004) goes further to highlight that child centred methods such as pair and group work are good for preparing learners to take up challenging jobs at work places where team work is the key to success. Child centred teaching methods prepare learners for team work at a tender age. Employers in the modern corporate world prefer people who are good team players Denig (2004).

2.5.5 Promotes intrinsic motivation to learn

Barbara (2007) attests that the child centred methods recognise and validates the learners' point of view. This recognition generates confidence and self-esteem which in turn motivates the learner to continue contributing in class, and being eager to tackle more complex themes and problems in the subject area. Barbara (2007) reviewed several studies on child centred approach over a long period of time, and found that overall it is an effective approach. Her six year study in Helsinki, compared the traditional and the child centred approach to learning, and found that the child centred group developed better study skills and understanding than the traditional group that wanted to be spoon fed by their teachers. She also discovered that the child centred approach enabled learners to increase participation, motivation, and performance in class tests and exercises. This proves that to learners, a child centred approach is interesting and exciting.

In line with the above assertion Thornburg (2005) contends that, the child centred approach to teaching and learning aims to satisfy needs of all learners. He attests that by providing learners with efficient learning strategies they tend to develop in them a greater degree of responsibility in their own learning. Learners also develop skills of managing all the processes of their learning. Thornburg (2005) continues to argue that some of the major attributes to the child centred approach are meeting the various needs of learners and cultivating a sense of responsibility in learning.

2.5.6 Meeting the various needs of learners

The various needs of different learners can only be met sufficiently according to Thornburg (2005) if learners themselves are involved. This assertion is supported by Kember & David (2009) who argues that the satisfaction of different learners' needs in class is an essential requirement to achieve effective teaching especially in classes where learners have different learning abilities, motivation levels, self-discipline, intelligence and literacy as well as interests and attitudes. Kember & David (2009) continues to argue that the traditional teacher-centred method in classes with diverse learners cannot promote meaningful learning, because those methods grossly ignore learners' contributions in class, and their individual differences. Contrary to the traditional teaching methods Thornburg (2005),

Kember (2009) argue that the child centred approach teaching methods focus on learners' experiences, background, talents, capabilities, interests and needs. This is seen by them as motivating learners and also making it possible for them to grasp concepts during the learning process, because the learning process will be relevant and meaningful to them.

2.5.7 Developing the sense of responsibility in learners

Thornburg (2005) continues to argue that developing the sense of responsibility in learning is an effective means of placing at the same level learners and their teachers in education. Doing so according to Thornburg (2005), assist in the establishment of a safe and free teacher learner relationship in classrooms. To allow learners to take full responsibility of their learning shows that the teacher respects them and their capabilities. If this is the case then learners tends to put more effort in their school work as a way of showing appreciation of the respect accorded to them by the teacher. This is the case because a strong sense of responsibility in learning means active involvement of learners in class. This is opposed to the traditional teacher centred teaching environment, where learners usually regard their teacher as a fountain of knowledge in class, who is the expert and only resource person that learners are supposed to rely on always Barr & Tagg (1995) cited in Kember & David (2009). If such a scenario is allowed to persist in class unabated Thornburg (2005) argues it tends to impair the learners' self-esteem and determination, because learning is an interactive process where learners are supposed to express their views and opinions freely. Too much dependence on the teacher reduces such vital interactions. It also reduces learners' engagement with the content being taught. It is there-fore under this background that the child centred approach advocates for an active engagement in learning in classrooms, and also requires learners to take full responsibility for their learning in order to achieve favourable outcomes coupled with a good teaching and learning environment.

Newble (1995) on the other hand argues that child centred teaching methods such as pair and group works are of utmost importance in multicultural classrooms. He asserts that instead of the teacher dominating proceedings in class using one cultural lance, he/she must allow learners to engage with the content in pairs and groups in order to share and appreciate their diverse cultural dimensions. This point is vital and relevant to the South African schools and classrooms. According to the Department of Basic Education (2012) the composition of South African learners is diverse, since these learners are coming from different socio-economic, Religious, racial, ethnic and cultural backgrounds. Due to this heterogeneity learners have different cultures and languages in South Africa. In order to deal with this diversity and heterogeneity the versatile child centred approach is the way to go, because these approaches are dynamic and versatile enough to embrace such diversity. This is the case because the child centred approach allows learners to work together, and to showcase their own cultures freely while at the same time appreciating and learning other learners' culture through interactions and co-operative learning techniques.

Barr & Tagg (1995) cited in Kember & David (2009) lists and explain the benefits of the child centred approach as follows:

2.5.8 Permits opportunities to connect the content to real life

In a Natural Science class for example, Barr & Tagg (1995) cited in Kember & David (2009) assert that learners can easily connect the subject content to real life because Natural Science content is real. The teacher simply needs to conscientise them that Natural Science as a subject applies to their everyday life. This pertains to issues such as preparing a balanced diet that has all vital ingredients for the body. Learners can go and prepare a balanced diet at their homes after learning about it as a topic in a Natural Science class. This will make learning of Natural Science more meaningful to them since they will be seeing the link of its content with their real life at their homes.

2.5.9 Provides opportunities for higher order thinking as opposed to passive listening

Barr & Tagg (1995) cited in Kember & David (2009) accentuate that child centred teaching methods provide opportunities to learners for high order thinking as opposed to passive listening, because the child centred approach allows learners to do things on their own, and as well solve problems on their own. This is possible for example in a Natural Science class where the teacher can give learners cells, wires, bulbs and then task them to light the bulb using these materials. Such a task allows learners to think creatively about how they are supposed to use the given materials correctly to make the bulb light. Such a task also allows learners to collectively use their psychomotor and cognitive skills that are encouraged to be used in Bloom's Taxonomy. According to Mutschning & Holzinger (2002) the combination of psychomotor and cognitive skills make learners to be creative thinkers rather than passive listeners as the case is in a traditional approach where the teacher does everything in class with learners playing the role of passive spectators.

2.5.10 Promotes learner-learner interaction

The child centred approach according to Barr & Tagg (1995) cited in Kember & David (2009) allows learners to interact with each other when they are given pair or group work. During presentations such interactions are also promoted, because learners tend to debate and ask each other questions freely for the purposes of sharing pertinent information, views and ideas. This view is in line with the assertion of Sparrow (2000), Kember & David (2009) where they argue that child centred teaching methods such as the project approach allow learners to partake in a project together as a group by preparing for an investigation together, gathering and collating information together and as well as presenting their findings together. They go on to argue that such projects promote learner-learner interaction which is a vital ingredient in learning, because it enriches learners and also teaches them to respect each other's views and opinions. Sparrow (2000) contends that learner-learner interactions make learners appreciate that problem solution is not prescriptive, but a problem can be solved through different ways and techniques.

2.5.11 Increase student retention

Sparrows (2000), Donald (2008) are of the opinion that students retention rate increases because in a child centred learning process students learn by doing, for example when it comes to the experiments like mixing water and sulphuric acid in the Science lab, the teacher can give learners an opportunity to do the mixing practically so that they can practically understand how these two substances can be mixed without causing dangers that are likely to harm them in the laboratory. Learners tend to understand concepts better when they learn by doing. The high retention rate is also promoted by the fact that in a child centred teaching scenario the teacher takes a back stage and allows learners to take a centre stage in order to enable them to learn through interacting and discussing with each other. This is very important in class, because learners learn better from each other than from the teacher Sparrows (2000).

2.5.12 Provides for improvement of social interaction skills, greater acceptance of others, and a greater sense of community in the classroom

Barr & Tagg (1995) cited in Kember & David (2009) accentuates the fact that since in most classes learners are coming from different backgrounds and cultures, the child centred approach teaching methods such as pair and group work as well as the project method allow them to work together for the same cause. They go on to say that Religious and cross cultural pollination tend to occur during these group or team discussions, and in the process learners tend to be exposed to different cultures which they tend to appreciate and respect. This appreciation and respect of each other's culture enables learners to co-exist and live in harmony as a miniature community in classrooms and in the whole school, as well as in the society at large.

2.5.13 Encourages creativity in both teaching and student involvement

Barr & Tagg (1995) cited in Kember & David (2009) argue that, due to the fact that in a learner centred approach, learners are involved in problem solution and learn by doing, this leads to creativity and innovation on the side of learners. Kember & David (2009) accentuate that child centred teaching methods expose learners to different mathematical and scientific problems to solve individually or as a group. They go on to say that if learners are exposed to problem solution scenarios at a tender age, they grow up to be adults who are creative and good in solving problems in their communities and work places.

Weimer (2002) attests that the use of child centred teaching methods have the following benefits:

- Responsibility is shared between the teacher and the learner.
- Learners develop learning skills for further education.
- Learners become self-directed lifelong learners.
- Learners are enabled to assess their own learning, and they become proficient in self-assessment.

- Learners also become proficient with information literacy skills, such as assessing and evaluating sources of information, so that they can use internet information wisely.

From the above given benefits of the child centred approach to teaching, it is evident that the child centred approach has enormous benefits in education, because it involves learners and make them innovative and creative thinkers through active involvement during lessons. Allowing learners to share ideas and learn from each other motivates them to be eager to learn and to continue learning more. It also enables them to grasp concepts better, because students learn better from each other, and when they are involved during the lesson. The child centred approach is also beneficial according to the above arguments because it enables learners to take full responsibility of their own learning and education. Instead of the teacher taking a centre stage and spoon feeding learners as if they were a tabula rasa during the lesson, like the case is in the traditional approach, the teacher takes a back stage in the child centred approach and allows learners to take a centre stage and discover things on their own, with the teacher playing the role of a facilitator. Teaching learners to take full responsibility of their own learning according to Weimer (2002) grooms them to be responsible adults who will take full responsibility at work and communities, than developing a dependence syndrome to be spoon fed always even up to adult hood. It can there-fore be said that the child centred approach is a vital element in education that prepares learners for autonomous adult roles when they finally graduate from school into communities.

2.6 Challenges associated with the child centred approach.

Though the child centred approach has enormous benefits as discussed in the previous sub-topic, it is how-ever imperative to highlight some few challenges associated with it. Doing so will make teachers to be aware that such challenges exist. This would enable them to plan for child centred teaching methods from an informed point of view.

All teachers in general, and Natural Science teachers in particular need to be made aware that the child centred approach despite its popularity it has is not without its own critics and challenges that teachers need to be aware of so that they can attend to. Chan (2001) describes the child centred approach as a Western approach to teaching and learning, and may not necessarily transfer to developing countries, like for example African countries where there are limited resources and different learning cultures, coupled with a phenomenon of large classes. He argues that if the classes are too large and resources are scarce, it becomes difficult for teachers to determine and fulfil the different needs of different learners in class. This opinion is supported by Hedge (2000) who lists the challenges of the child centred approach to learning as follows:

- Teaching of abnormally big classes.
- Lack of or inappropriate text books, learning media and material.

- Lack of teacher involvement in the curriculum development process, syllabus development and selection of text books.
- Shortage of qualified or well trained teachers capable of successfully implementing the child centred teaching methods.
- Novice teachers are not provided with sufficient induction and orientation on child centred teaching methods and strategies.

The challenges highlighted by Hedge (2000) above are further aggravated by the assertion of the Department of Basic Education (2013) that in many underprivileged schools in South Africa there is a serious shortage of qualified teachers, equipment and materials for practical subjects such as Sciences, Computer Applications and Technology (CAT), Hospitality Studies and the like. It has to be noted therefore that lack of such equipment and materials for these subjects makes it difficult for teachers to use child centred teaching methods, because Hedge (2000) contends that such methods require each and every learner to be directly involved in the learning process. He/she needs his/her own apparatus, chemicals and computer, so that he/she can have a chance to be involved and manipulate things practically during the lesson. This can only be possible if there are adequate equipment and materials that would enable learners to have a practical feel and manipulation of these materials and equipment in line with the objectives of the lesson. Another concern highlighted by the Department of Basic Education (2013) is that most teachers in schools are computer illiterate; as a result they can't manage to use computers to implement and enhance more engaging child centred methods that are only possible through the use of computers as a medium of instruction in classrooms. It can then be said that computer illiteracy on the part of the teachers is problematic in the implementation of the child centred methods, for example if the Natural Science teacher wants to present information about volcanoes in video, audio and text, he/she may only succeed to do so if he/she uses a power point projector connected to the laptop or computer. If the teacher is computer illiterate he/she cannot manage to plan for and go on to execute such a lesson.

Blumberg & Everett (2005) on the other hand argue that the child centred teaching methods can only be implemented successfully in small classes. They see it as a problematic approach to be implemented in large classes. In most schools in South Africa according to the Department of Education (2012) classes are too big due to high demand for education that exceeds supply. McCombs & Whistler (1997) argue that the challenges of implementing the child centred approach teaching methods in schools are:

- Lack of teacher confidence in trying new methods and strategies.
- Teachers fear that child centred teaching methods slow down the pace of syllabus and content coverage.
- Teachers fear that child centred methods take away their authority and control in class, as a result the use of such methods can result in the class going out of control.
- Lack of adequately prepared material for use in classrooms.

- Lack of background experience or training by teachers in the use of active child centred learning approaches.
- Failure to introduce learners to the child centred methods at an elementary or junior phase educational levels.

2.7 Child centred teaching methods.

Bell (1999) asserts that empirical evidence has proven that there are many child centred teaching methods that teachers can use in class. Which method to use is determined by a number of factors, for example availability of resources, the topic being covered, calibre of learners, as well as the teachers' expertise and experience on particular methods. It is therefore important for the teacher to choose an appropriate method for the lesson than to choose for the sake of choosing.

Authorities such as Bell (1999), McInnis (2000), Burdett (2003), Erickson (2007), Thornburg (2005) and others, suggested the following child centred methods and strategies to teaching and learning in classrooms: Brainstorming, group work, debates, using ICT, case studies, discussions, questioning, laboratory teaching, facilitation.

2.7.1 Brainstorming

Brainstorming according to Erickson (2007) is where-by a large or small number of students is given a task to focus on a topic and contribute to the free flow of ideas. The teacher may begin a brainstorming session by posing a question or a problem, or by introducing a topic. Students then express possible answers and relevant ideas. These are then examined in an open class discussion. Anderson (2005), Armbruster (2009) & McDaniel (2007) argue that brainstorming allows student to think in pairs or groups about the answer to a question posed by the teacher. They first of all discuss the question among themselves and the teacher selects group representatives to explain the consensus to the whole class.

2.7.1.1 Effective brainstorming

Erickson (2007) is of the opinion that if the teacher wants brainstorming to be effective in both small and big groups, he/she should select a group leader and a secretary, define the problem or idea to be brainstormed, and make sure that all learners have understood the idea or topic to be explored. Smith (2011) contends that the teacher has to set up the rules for a brainstorming session. Smith (2011) asserts that these rules can include:

- Setting a time limit for the whole brainstorming session and for individual learners' contributions in the brainstorming group.
- Recording each idea or contribution made by group members.
- Allowing everyone in the brainstorming group to contribute.
- Suspending evaluation of ideas prematurely. There must be a wait until all ideas have been gathered.
- Empowering the selected leader with authority to control the brainstorming session.

2.7.1.2 Benefits of using brainstorming

Erickson (2007) argues that brainstorming has the following fundamental benefits:

- By expressing their own ideas and listening to what others say, learners are able to adjust their previous knowledge or understanding, and as well accommodate new information and increase their level of awareness.

Brainstorming according to Derting & Ebert-May (2010) also:

- Focuses learners' attention on a particular topic or problem.
- Generate a variety of rich ideas.
- Teaches learners to accept, and respect each other's ideas and different opinions.
- Encourages learners to share their opinions and ideas in order to expand their existing knowledge by building on each other's' contributions.
- Introduces learners to a practice of collecting ideas prior to beginning tasks such as writing or solving a problem.

It is also important to highlight that though brainstorming has vast benefits highlighted above, but it has some minor challenges. Erickson (2007) supported by Smith (2011) highlights that some learners may be reluctant to cooperate and speak in a group setting. In light of the above teachers should therefore encourage all learners to speak and, to be good listeners at the same time during brainstorming sessions in class. Smith (2011) goes on to say that in order for brain storming sessions to be a success the teacher must come well prepared. He/she should have guidelines that are supposed to be followed by learners during brainstorming sessions.

2.7.2 Group work

Group work or cooperative learning according to Burdett (2003) & Preszler (2009) is a method of instruction that allows learners to work together in groups. Preszler (2009) is of the opinion that nowadays it is important for learners to work co-operatively as a group, because even after they have completed schooling, at work places employers value a person's ability to work co-operatively due to the fact that in contemporary work places, people work in teams which are usually cross disciplinary and quite diverse. In light of this it can be said that South African learners are as diverse as their communities. So working in groups in class would enable learners to come into terms and cope up with diversity issues at a tender age. This would positively prepare them for reality at work places and societies.

2.7.2.1 Using group work effectively

Burdett (2003) argues that, if groups are to be used effectively in class, the teacher should:

- Develop learners' group work skills by helping them learn how to identify group issues, listen reflectively, and give constructive feedback, structure discussions. Manage their groups, give group presentations and compile reports. Review individual learner's contribution.

- Help learners to monitor their development, reflect on their performance and identify how they can improve.
- Clearly explain the tasks to all group members, and also explain what is expected of them. All these instructions should be well explained to learners in groups before group discussions begin.
- Equip learners with assessment skills and criteria to assess their group work in general and their own contributions in particular.
- Arrange proper sitting plans well in advance.

The points highlighted above by Burdett (2003) are supported by Wright (2006) who asserts that the success of using groups in learning is strongly dependent on the teacher's approach. The teacher has to tell students what they are expected to do during discussions. Wright (2006) continues to say that if learners are not aware of what they are supposed to do in their respective groups they tend to make noise discussing their personal issues during group sessions.

2.7.2.2 Benefits of using group work

Fink (2004) argues that group work has the following benefits:

- Allow learners to be active participants in their own learning.
- Help learners develop skills such as problem solving, negotiation, conflict resolution, leadership, critical thinking and time management. These skills are vital in societies and the corporate world.
- Exposes learners to diverse ideas and approaches, and enable them to appreciate that a problem can be solved in many different ways, and that it can be solved better through combined effort and ideas.
- Acknowledges and utilises individual learners' strengths and expertise through discussions.
- Help learners articulate their ideas, refine concepts and develop interpersonal and communication skills.
- Allows learners to experience situations that resemble the workplace, for example authentic real world projects.
- Facilitates learners' deeper understanding of the content, because learners learn better from each other.

2.7.2.3 Challenges of using group work

Though group work has huge positive results, it has to be noted that it has its own challenges. Fink (2004) cited in Erickson (2007) argues that:

- Some learners, especially those who do not feel confident about their ability to communicate in English prefer to work independently, as a result they find group experience challenging and confronting.

- If the class is too big, it becomes problematic to use group work, because it becomes impossible to control learners, and noise levels are likely to escalate.
- At times group work may prove to be time consuming.

Teachers there-fore should be aware of problems and challenges associated with the use of groups so that they take these into consideration when planning for group work. Fink (2004) cited in Erickson (2007) attests that group work can only be successful if the teacher plans properly, and if he/she equips his/her learners with skills and attitudes of being good and productive group leaders.

2.8 Debates

Andresen (2000) asserts that debates are structured ways of exploring a range of views on an issue. They consist of a structured contest of argumentation, in which two opposing individuals or teams defend and attack a given proposition. In line with this assertion Newble (1995) contends that debates are one of the most effective child-centred teaching strategies, especially when dealing with complex topics or controversial contemporary issues such as industrial waste pollution. This is true, because in Natural Science for example many issues and topics can be debated by learners in order to generate more information or to clarify certain issues. These topics can include the following:

- Indigenous knowledge is no longer relevant to modern societies.
- Indigenous knowledge is not scientific; as a result it doesn't have a place in the modern scientific curriculum.
- Big companies must be banned from operating in communities, because they pollute and degrade the environment.
- It is better to stick to indigenous knowledge than to adopt Western knowledge.
- Traditional herbs treat HIV/AIDS better than modern Western drugs and medicines.

If these topics are debated by learners in a science class they are likely to generate a lot of interesting ideas. Lambert & McCombs (2000) attest that learners are motivated to learn in class if they are given an opportunity to debate issues in class, especially those issues that are relevant to life in their societies.

2.8.1 How to achieve effective debating

Newble (1995) is of the opinion that if the teacher wants to use debates effectively he/she has to:

- Brainstorm topics and allow learners to present them as statements with a strong and clear point of view, for example, jobs are important than the environment.
- Set up the room appropriately.
- Give learners sufficient time to prepare for the debate.

- Divide the class into teams, for example a team of three movers of the topic, and three opposers. Other learners can be given roles of time keepers, moderators or adjudicators.
- Give debaters an agreed time line in which they can speak. Emphasis should also be given on speaking in an orderly manner.
- Develop the criterion that is going to be used to assess debaters and allocate points in order to come up with the winners of the debate.

2.8.2 Benefits of using debates

Erickson (2007) attests that when used appropriately in class debates:

- Engage learners in a combination of activities that enable them to interact with the curriculum.
- Force learners to consider facts of the situation and its implications.
- Encourage learners to think critically about their own position as well as their opponents'
- Force learners to carry out intensive and extensive research about issues or topics to be debated.
- Develops learners' oratory and listening skills.
- Enable learners to develop their research skills, knowledge, speaking and listening skills, as well as their social skills in communicating and working with others.

Johnson (2004) accentuates that learners who are given an opportunity to debate in class tend to have higher self-esteem and confidence in whatever they do both at school and in the society. Alexander & Murphy (2000) go a step further and say that learners who participate in debates at school tend to develop confidence and become leaders in societies when they finish their studies at school and graduate into communities.

2.9 Using ICT in teaching Natural Science

Integrating digital media into the classroom according to Harris & Morris (2009) is one of the contemporary methods of teaching that promotes learner involvement in class. They proceed to say that several software packages have been developed to give students practice to test and evaluate themselves. This helps them to extend and challenge their understanding. Harris & Morris (2009) accentuate that these software can encourage learners to help each other, and come for lessons in class for help only after they have worked the problem and sought help from others first. The use of ICT according to Harris & Morris (2009) enables teachers to communicate with students electronically through e-mails. Students with the help of the teacher can set up chat groups on specific topics to generate questions and answers amongst themselves. Harris & Morris (2009) continue to assert that the most successful use of ICT is probably where learners learn to ask questions, and to learn from each other, so that personal learning networks are established and supported by teachers in schools.

In line with the above assertion, Shelly, Gunter & Gunter (2010) attests that when teaching Science Subjects, the teacher can refer learners to appropriate websites where there are videos as well as text material explaining the life cycle and food chain of different living organisms. Watching these videos and reading information about the food chain of these organisms would help learners to understand the topics such as food chain and life cycle of organisms better in class. Through the use of the internet, science students can also navigate sites that have videos and information on soil erosion, volcanic eruption, and space exploration. If the teacher links his/her learners to such sites, they will be able to discover information about these topics on their own, making it easy for them to grasp concepts if such topics are taught in class.

2.9.1 Benefits of using ICT in teaching Natural Science

Heinich (2006) contends that the introduction of ICT in class enabled learners to access information from the internet with the highest speed without going to the library or purchasing volumes of books. He continues to argue that ICT makes it possible for teachers to administer exercises to learners on-line without necessarily meeting with them physically. He accentuates that learners through e-mails and chat rooms can share information and exchange ideas. Heinich (2006) also asserts that learners' group discussions and consultations of teachers through the use of ICT continue even after normal school hours.

Shelly, Gunter & Gunter (2010) argues that integrating technology into the curriculum enables educators to integrate technologies such as computers, CDs, DVDs, digital cameras, application soft wares, digital media applications and devices, e-books and electronic references, net book computers, iPods, and the web into almost any classroom situation. This is important especially in science subjects where learners learn better by seeing and doing rather than being told. If the teacher for example is teaching a topic on the digestive system of ruminants and non-ruminants, he can use on-line videos in the computer lab showing these two types of digestive systems. This will enable learners to practically see the similarities and differences of these digestive systems without being told. Shelly, Gunter & Gunter (2010) continue to assert that many topics are taught better through the use of digital media integration into the curriculum in the classroom. Digital media makes it possible to concurrently use, simulations, animations, video, audio, and text. If this happens in class learners are able to understand concepts better. The digital media makes the life of the teacher easy in class, because even if the teacher does not have resources to take learners to gorges, craters, planetariums, Savannahs, deserts, and river banks, he can bring DVDs of these areas and give them to his learners to navigate through on their computer and lap-top screens without having to travel for long days and hours to physically reach these places. Bonk (2007) and Taylor (2000) on the other side contend that, ICT can enable learners to access on-line libraries at the comfort of their homes and classrooms. This according to them encourages the culture of research and studying on the part of learners. It also assists and encourages them to do their homework independently without bothering and relying on the teacher for information. Laik (2003) argues that learners tend to be

motivated and become eager to learn if they can easily access information that they need for their studies.

2.10 Case studies in teaching Natural Science

Case studies are defined by Andresen (2000) as stories or scenarios that are in narrative form. They are created and used as a tool for analysis and discussion, and are often based on actual events, which adds a sense of urgency or reality.

2.10.1 How to use case studies effectively in teaching Natural Science

Andresen (2000) asserts that case studies can be used effectively to teach in class if the case content is aligned with the course content, learning objectives, teaching and assessment strategies in the subject area. Andresen (2000) advises teachers to:

(a) Use complex cases requiring multiple perspectives.

He attests that a good case is the one that has enough detail to necessitate research and stimulate analysis from a variety of viewpoints and perspectives. It also places the learner in the position of problem solver, because it enables learners to actively engage with the materials and discover underlying issues.

(b) Assess the process of analysis, not only the outcome.

Andresen (2000) continues to argue that, when using case studies, teachers should observe and evaluate the quality of research, organisation of arguments, the feasibility of solutions presented, intra-group dynamics, and evidence of consideration of all case factors. He also argues that it is also important for teachers to note that case studies may be resolved in more than one manner.

(c) Use a variety of questions in case analysis.

Andresen (2000) is of the opinion that when analysing case studies teachers have to use a range of question types in order to enable the class to move through the stages of analysis.

2.10.2 Challenges of using case studies

The challenges that teachers are supposed to take note of when using case studies, according to Stuart (2009) are to get learners to talk and keeping the class moving. He proceeds to say that, since case study analysis is led by learners, it can then be difficult to get the class to move through various stages of analysis and arrive at a reasonable conclusion. Stuart (2009) argues that these challenges can how-ever be dealt with or reduced through effective planning before using case-studies.

2.10.3 Benefits of using case studies

If used appropriately Stuart (2009) supported by Andresen (2000) argues that case studies yield some positive results. He asserts that case studies enable learners to practically apply their skills, and their understanding of learned facts to a real world situation. Stuart (2009)

continues to attest that case studies are particularly important where situations are complex and solutions are uncertain, they can be used as a project for individuals or groups of learners. A single case can be presented to different groups in order to allow each group to offer its solutions. Case studies also bridge the gap between a more teacher centred teaching approach and a pure problem based learning, because they leave a room for teachers to give direct guidance, and provide hints and parameters within which the students must operate.

In line with Stuart (2009), Andresen (2000) is of the opinion that if case studies are used appropriately as a tool of teaching, they:

- Engage learners in research and reflective discussion.
- Encourage higher order discussions.
- Facilitates creative problem solving.
- Creates an opportunity for learners to learn from one another.
- Allow learners to develop realistic solutions to complex problems.
- Enable learners to apply previously acquired skills.
- Develop learners' ability to identify and distinguish critical and extraneous factors.

2.11 Assignments

Estaire & Zanon (1994) contend that assignments are the best way of involving learners in class. If learners are given assignments to accomplish by the teacher, they become more involved, as they practically search for information needed to complete given assignments. Estaire & Zanon (1994) go on to say that, assignments also develop, and improve learners' research skills. This is seen by them as making learners to grow towards autonomy in learning, as it equips them with skills of discovering information on their own, hence managing to learn on their own. This is autonomy in learning as opposed to a situation where by learners wait to be spoon fed by the teacher.

When it comes to the administering of assignments, Hedge (2000) attests that assignments can be administered through giving learners tasks to:

- Design their own experiments especially in science and Agricultural science subjects.
- Set their own research topics or essays. Research topics for example can include the reproductive system of human beings, the difference between a plant and an animal cell, the rain-fall cycle.
- Work in a project individually, in pairs or as a group.
- Deal with a problem and generate their own question about it, rather than the teacher doing it for them. This promotes problem based learning.
- Reflect on their learning.

In Natural science for example study and hand books can be used to encourage learners to reflect and give feed back to their teachers on how they understand given topics.

2.12 Discussions

The term discussion is defined by Jennifer (2006) as the act of talking about something with another person or a group of people, for example learners engaged in a heated discussion about disposal of industrial waste material into community streams and rivers. On the other hand Fink (2004) asserts that a discussion is a speech or piece of writing that gives information, ideas, and opinions about something or a topic. For example in Natural Science learners discussing about the effects of global warming to the environment. In the process of discussing this topic learners are likely to come up with the positive and negative effects of global warming to the environment. Since Fink (2004) argues that when discussing learners tend to generate a lot of information about an issue or topic being discussed, it is therefore possible that in the process of discussing this topic, learners are also likely to come up with the causes of global warming as well as ways of avoiding or reducing global warming.

2.12.1 Effective discussion strategies

In order for discussions to be effective and fruitful in class Jennifer (2006) concur with Taylor (2000) when suggesting that teachers should, set clear expectations for students participating in discussion sessions. She continues to say that, the teacher has to let learners know from the first day in class that their performance in the subject area will be determined by how effectively they participate in class discussion session, and this will depend on the number of times they comment and on the quality of those comments.

According to Fink (2004) in order for discussions to be a success in classrooms teachers should:

i. Encourage learners to contribute.

Fink (2004), Jennifer (2006) argue that the teacher can direct a discussion by asking questions before and during the session. These questions are the ones that should offer a starting point of the discussion. Jennifer (2006) argues that in order for the discussions to be live, questions asked should be open ended ones, for example, what are the effects of global warming? What are the effects of disposing industrial waste material into community streams and rivers? If such questions are asked, they are likely to encourage multiple view points from learners. Fink (2004) is of the opinion that, if the teacher records learners' responses on the board, he/she can go on to use them to generate further topics for discussions. Topics that can be further generated can include the following:

- What can be done in order to reduce global warming?
- What scientific methods can be used to dispose of industrial waste instead of disposing of it into community streams and rivers?

Asking such follow up questions arising from discussions would make learners to generate more ideas. They will also be motivated because they will realise that their views and opinions are being recognised by the teacher in class.

ii. **Direct the discussion**

Good teachers according to Fink (2004) know their learners' perspectives and skills. They then use this knowledge to decide which learner is capable to start a discussion in order to move it to the appropriate direction, and maintain its momentum. On the other hand Kember et al (2009) attests that, during discussions the teacher has to emphasise that students should listen to each other. He also argues that the main points contributed by learners should be noted on the board because doing so motivate learners and encourages them to continue contributing more during discussions.

a. **Control the discussion.**

Johnson (2006), Fink (2004) contend that the teacher has to make sure that vocal students do not dominate group discussions at the expense of other learners, and that the entire class does not hijack the discussion and move it to another issue. Johnson (2006) argues that if the teacher fails to control group discussions disorder and disruptions are likely to prevail to the detriment of the lesson and envisaged lesson success.

b. **Aligning discussion with the curriculum.**

Fink (2004) attests that to be truly effective, each discussion session must be aligned to the curriculum. The teacher must not bring discussions that are not related to the curriculum. This means that the teacher must design discussion questions in line with the curriculum objectives and outcomes.

2.12.2 Challenges associated with discussions.

Jennifer (2006) contends that the major challenge of discussions is for teachers to get learners to talk, and keep the discussion moving. Another common challenge according to her pertains to long digressions or pointless arguments by dominant students or groups, which can throw a discussion off track. These challenges according to Jennifer (2006), Johnson (2006) can be dealt with through orienting all learners to all basics and procedures of discussions before such discussions kick start. Johnson (2006) attests that in order to have quality discussions a discussion plan prepared in advance by the teacher can make this possible.

2.12.3 Benefits of discussions

If used appropriately discussions have huge benefits. Jennifer (2006), Johnson (2006) contend that discussions let class members work actively with the ideas and the concepts being pursued. Jennifer (2006) argues that discussions can be extremely effective in

changing behaviour and attitudes of learners. She accentuates that through discussions learners develop confidence and self-esteem, develop problem solving and critical thinking skills. Discussions are also seen by her as enabling learners to articulate a position in an informed opinion.

2.13 Questioning

Questioning is defined by Andresen (2000) as an interrogative sentence or expression that is often used to generate knowledge, explore an issue, an idea or something intriguing. Erickson (2007) asserts that the art of asking questions is at the heart of effective communication and information exchange, which underpins good teaching. Biggs and Tang (2007) cited in Kember et al (2009) accentuate that Socrates believed that to teach well, teachers must reach into a learner's prior knowledge and awareness in order to help the learner to reach new levels of thinking. This means that the teacher can use questions to draw from and build on students' prior knowledge and experience to help them to develop deeper understanding of the topic.

2.13.1 How can teachers achieve effective questioning?

Erickson (2007) attests that in order for teachers to be able to use questioning effectively in class, they should use a variety of question type, and also use varied levels of questioning. He proceeds to say that teachers should use the following types of questions: factual, convergent, divergent, and evaluative or a combination of these. He goes on to explain these types of questions as follows:

Factual questions are the types of questions that solicit reasonably simple, straight forward answers based on obvious facts and awareness. Erickson (2007) asserts that factual questions are usually at the lowest level of cognitive and affective processes.

Convergent questions

Kember (2009) concurs with Erickson (2007) that, convergent questions have answers that are usually within a very finite range of acceptable accuracy. These questions may be at several different levels of cognition, comprehension, application, and analysis, or the answer may have to make inferences or conjectures based on personal awareness, or on material read, presented or known.

Divergent questions

These questions according to Erickson's (2007), Douglas (2009) allow learners to explore different avenues and create many different variations and alternative answers and scenarios. Douglas (2009) accentuate that divergent questions often require learners to analyse, synthesise and evaluate a knowledge base and then project or predict different outcomes. The purpose of these divergent questions according to Erickson (2007) and

Douglas (2009) is to stimulate imaginative and creative thought, or investigative cause and effect relationship, or to provoke deeper thought or extensive investigations. These questions are therefore good in Natural Science, where learners are supposed to investigate a certain phenomenon up to the extent of conducting experiments. In most cases they predict results before experiments are conducted, and then go on to carry out experiments in order to prove whether their predictions were correct or not.

Evaluative questions

Erickson (2007) asserts that these are the questions that usually require sophisticated levels of cognitive, emotional or affective judgement. In trying to answer these questions learners combine multiple logical and affective thinking processes. Learners therefore need to analyse before answering these questions, because they are high order questions.

2.13.2 Tips to teachers

Kember et al (2009) provided some tips that would enable teachers to use questioning effectively in class. He advises teachers to:

- Plan key questions to provide structure and direction to the lesson.
- Phrase questions clearly and specifically, and avoid vague and ambiguous questions.
- Adapt questions to the level of learners' ability. This can be achieved through asking questions at various levels in a logical and sequential manner.
- Follow up on learners' responses in order to encourage them to continue participating in class.
- Give learners time to think after asking a question.
- Use divergent questions, as question types that are more likely to produce a wide range of answers.

2.13.3 Challenges associated with questioning

Biggs and Tang (2007) cited in Kember et al (2009) contend that the challenges of using questioning are almost similar to those of discussions. These according to them involve a challenge of getting learners to talk, pointless arguments which can derail the lesson. They go on to contend that, at times teachers tend to overuse particular type of questions. This can hinder learners from expressing their dynamic ideas. Biggs and Tang (2007) cited in Kember et al (2009), Douglas (2009) argue that these challenges can be best solved through asking learners relevant questions that are to the level of their cognitive development. The teacher also needs to keep learners focused during the questioning time in order to avoid unnecessary derailments. They also argue that, it is the teacher's duty to vary his types of questions in order to elicit dynamic and diverse responses from learners.

2.13.4 Benefits of using questioning

Through thoughtful questioning according to Biggs & Tang (2007) cited in Kember et al (2009) teachers can extract factual information from learners, and also help learners to connect concepts, make inferences, think creatively, and imaginatively, think critically, and explore deeper levels of knowing, thinking and understanding.

2.14 Laboratory Teaching

Omoosewo (2000) attests that the laboratory may be defined as a place equipped for experimental study. He continues to say that, the word laboratory in the minds of most people is synonymous with scientific investigation. On the other hand Stuart (2009) contends that laboratory teaching sessions are commonly used in the traditional science based labs, but they are also often used in other areas such as computing, medicine, engineering and design. This shows that laboratories cover a broader spectrum, and are likely to develop learners' knowledge and skills in a broader way.

2.14.1 Laboratory teaching methods

Laboratory teaching methods vary widely. Omoosewo (2000) asserts that there are two major types of laboratory teaching methods. 1) A situation where by learners work in the laboratory. 2) A situation where one person demonstrates. Omoosewo (2000) warns that, it must however be noted that in the laboratory teaching methods there is no substitute for the teacher circulating among the learners, answering and asking questions, pointing out possible applications and generally guiding students' learning.

2.14.2 Situation where students work in the laboratory

Omoosewo (2000) attests that in this situation learners work informally in pairs or groups where equipment cannot go round all learners individually in laboratories. He argues that in this scenario teachers can pose a carefully chosen sequence of questions to help learners design experiments which illustrate important concepts.

2.14.3 Demonstrations

Obrien (1990) cited in Omoosewo (2000) contends that demonstrations are a process of presenting or establishing facts and principles. It is a procedure of doing or performing something in the presence of others either as a means of showing them how to do it or illustrate a principle. Obrien (1990) cited in Omoosewo (2000) argues that demonstrations are effective for illustrating concepts in class, because they can provoke students to think for themselves, and they are especially helpful if the demonstration has a surprise, or if it illustrates an abstract concept or mechanism. He goes on to say that demonstrations that use everyday objects are effective, and they require little preparation on the side of the teacher. If everyday objects are used in teaching Natural Science then it becomes easy for learners to be involved and participate actively in class, because common objects that they are familiar with will be used. These common objects can involve cups, spoons and teaspoons as well as bottles that they usually use at their homes. Douglas (2009) argues that

using objects that learners know such as art objects make learners confident and interested in learning.

2.14.4 Benefits of using demonstrations

McKee (2007) lists the benefits of using demonstrations in the laboratory as follows:

- Demonstrations are an attention inducer and a powerful motivator when used to start or end a lesson.
- Where materials and time are important factors for a particular topic, demonstrations save time and material is economised as a big number of learners in class would require more time and material.
- Through demonstrations the teacher shows learners how to avoid breakages and accidents in the laboratory. McKee (2007) say that the teacher does this by showing learners the correct use of apparatus as well as how to secure reliable measurements and results.
- The demonstration method allows the teacher to carry out activities which are dangerous for learners to carry out, for example activities involving high voltages, or those involving highly explosive and dangerous chemicals such as nitric and sulphuric acids.
- Demonstrations allow learners to observe how a scientist thinks and proceeds.

2.14.5 Challenges associated with demonstrations

Though demonstrations have vast benefits, teachers should however beware that there are some challenges associated with the use of demonstrations. These challenges are highlighted by McKee (2007) who argues that demonstrations may:

- Not allow learners to develop manipulative skills, and learners do not satisfy psychological demands of carrying out activities on their own.
- Cause poor visibility especially for short students in large classes.
- Not allow students to be familiar with the equipment and material as well as observing and recording events.
- Not allow the use of other senses, because sight alone cannot provide most of the scientific information that learners can odour and texture, since this require close observations and touch respectively.

2.14.6 Planning for demonstrations

O'Brien (1990) cited in Omosewo (2000), McKee (2007) both concur on the fact that in order for demonstrations to be a success teachers must thoroughly prepare for them. McKee (2007) goes on to attest that when preparing for demonstrations teachers should ask themselves the following questions:

- What concept does the teacher want to illustrate or demonstrate?

- Which of the many demonstrations on the selected topics will generate the greatest enhancement in student learning?
- Where in the class will it be more effective?
- What prior knowledge should be reviewed before demonstrations?
- What design would be most effective, given the material in hand?
- Which steps in the demonstration procedure should be carried out ahead of time?
- What questions will be most appropriate to motivate and direct learners' observations?

McKee (2007) argues that well thought answers to these questions would result in the successful use of demonstrations in the science laboratory.

2.14.7 Benefits of laboratory methods

Omoosewo (1994) cited in Omoosewo (2000) contends that the importance of laboratory method is that, it enables learners to understand science and technology processes, because learners participate and develop critical thinking skills. The manipulation of experiments, operation and interpretation of data by learners enable them to acquire suitable scientific skills and attitudes.

Omoosewo (2000) argue that, laboratory methods enhance learners' abilities in:

- Identifying problems and questions.
- Categorising of attributes through observations, comparison of differences and similarities.
- Measuring qualities.
- Manipulation of material and data.
- Formulation of hypotheses.
- Ability to investigate variables and work on effective ones.
- Making conclusions/decisions based on established facts.

These points clearly show that laboratories are good places for teaching Natural Science, because they enable science learners to prepare for investigations in the form of experiments, conduct an investigation, record, analyse and communicate findings. Doing so grossly develops their science process skills. Learners' involvement in class when this method is used reaches its maximum levels. Douglas (2009) concurs with Omoosewo (2000) on the fact that laboratory methods can be used in line with field tours, where by learners go to the field and collect living and non-living organisms, and then carry out demonstrations and experiments on what they collected in the field. For example, learners can collect green tree leaves in the field and then bring them to the laboratory to test them for oxygen. Learners as well can collect living organisms such as frogs in the field, and then take them to the science laboratory to dissect them in order to find out more about the digestive system and the respiratory system of such organisms.

2.15 Facilitation

Facilitation according to Bell (1999) is the process whereby the teacher acts as a facilitator of learning than a transmitter of information. The teacher only stimulates and facilitates learning, and let learners do the rest. He can only stimulate discussions and contributions from learners through asking questions, giving pair and group work. Bell (1999) also argues that after learners have discussed in pairs and groups, the teacher can then give them opportunities of making presentations to the whole class. These presentations can be done using charts and posters if necessary.

In order for the lesson to be more interactive, Bell (1999) and Simon (1999) argue that the teacher should encourage the rest of the class to comment and ask questions on presentations made. The teacher's role during facilitation is to prompt and stimulate student participation. It is also the teacher's role according to Bell (1999) and Simon (1999) to keep on probing students so that they can say more and give a lot of required information. They see prompting, stimulating and probing by the teacher as resulting in student involvement and centredness during lessons in class. Bell (1999) supported by Simon (1999) goes on to argue that through probing and stimulation students gain adequate information than by listening to the teacher for long periods. He proceeds to say that, listening to the teacher preaching for longer periods is not effective, because human beings have short or limited attention spans.

All the information given above show that learners only benefit during the lesson if the teacher assumes the role of a facilitator, and allows them to do the rest instead of him/her dominating in class with learners playing a passive and boring role of being listeners. Natural science teachers there-fore in light of this need to allow learners to play a vital role in class during lessons, and teachers have to play the role of facilitators of learning.

2.16 Assessments used in the child centred approach.

In the child centred teaching approach the processes and purposes of assessment according to Blumberg (2008) shifts from assigning of grades to include constructive feedback and to assist with improvement. This then means that the child centred teaching approach uses assessment as a part of the learning process. Blumberg (2008) continues to assert that in the child centred teaching approach, criterion- referenced, formative and summative assessment methods can be used.

Gibbs (2006) is of the opinion that learners need to be involved in assessment when implementing the child centred approach teaching methods. His assessment process is illustrated in the table below.

Table 1: assessment process and child centred learning.

<p>Involving learners at the stage when the task is set.</p>	<ul style="list-style-type: none"> • Choosing the assessment task. • Setting the assessment task. • Discussing the assessment criteria. • Setting the assessment criteria.
<p>Involving learners at the stage after the task is completed.</p>	<ul style="list-style-type: none"> • Making self-assessment comments. • Making peer assessment feedback comments. • Suggesting self-assessment grades/marks. • Negotiating self- assessment grades/marks. • Assigning self-assessment grades/marks. • Assigning peer assessment grades/marks.

Adopted from Brown, Rust and Gibbs (2006)

The information summarised in the above table shows that in the child centred approach scenario, learners are involved and they also partake in their assessment right from designing the assessment criteria up to implementing it.

On the other hand Jahassen (1999) cited in Chan (2009) argues that teachers in the child centred approach have to assess learners for the achievement of specific learning objectives and outcomes. He attests that the best forms of assessment are those that are aligned with the learning goals, and the teaching methodologies that are used and designed to give feedback to learners. Teachers need to harness assessment to encourage the sort of learning outcomes that are being sought.

Kember & David (2009), Chan (2009) attests that in the child centred learning; emphasis is made on knowledge, attitudes, and skills such as:

- Problem solving.
- Thinking for one-self.
- Understanding.
- Responsibility for one’s learning.
- Independence and co-operation.

In line with the above assertion Johassen (1999) cited in Chan (2009) is of the opinion that assessment in the child centred approach drives learning more than anything else, because it represents the bottom line of learners’ performance. He believes that all assessments in a child centred teaching approach should require that learners present evidence of their learning. He continues to say that, if teachers really believe in child centred learning, then

they must work hard to ensure that their assessment practices reflect, encourage and reward this belief.

2.16.1 Assessment forms in the child centred teaching

One of the main reasons for using examinations as a tool of assessment according to Cook (1998) is to ensure that teachers see the learners' work. He proceeds to assert that, however to assess the learning outcomes that are not reliant on short term memorisation, a range of assessments can be used during the term. Cook (1998) adopted the following table from Main (1993:14). This table indicates a wide range of assessments, as well as outcomes that are realised through these forms of assessments as the case is highlighted below in the table.

Table adopted from Main (1993:14)

Forms of assessment	Examples of objectives
Project work	<ul style="list-style-type: none"> • Seeks information. • Reason and plan study in appropriate depth. • Organise information for special purposes. • Present ideas. • Sustain appropriate motivation.
Take home essay or assignment	<ul style="list-style-type: none"> • Prepare arguments and analysis. • Seek relevant information. • Organise effective presentation. • Integrate ideas or theories. • Express ideas in appropriate manner.
Questions or assignments proposed by learners and approved by teachers.	<ul style="list-style-type: none"> • Show knowledge of syllabus aims. • Display understanding of structure and materials. • Display understanding of key issues.
Group project	<ul style="list-style-type: none"> • Cooperative work in order to develop team work skills. • Benefit from real life situation. • Evaluate personal skills. • Integrate with other views or models.
Simulated tasks	<ul style="list-style-type: none"> • Show appropriate attitudes. • Interact with others and apply knowledge or experience. • Analyse and synthesise ideas. • Display creativity or imagination.
Oral communication	<ul style="list-style-type: none"> • Cope with questions and arguments. • Show reasoning behind statement and ideas • Interact with others.

	<ul style="list-style-type: none"> • Use general or technical language in an appropriate manner. • Express ideas fluently.
Open book examination	<ul style="list-style-type: none"> • Retrieve information and ideas from sources. • Reference material adequately. • Apply information to relevant situations. • Remember key ideas or structure.
Course work or continuous assessment	<ul style="list-style-type: none"> • Maintain appropriate motivation. • Develop techniques appropriate to syllabus aims and objectives. • Sustain interest and energy. • Relate different tasks to each other.

Adopted from Main (1993:14)

Cook (1998) is of the assertion that, if teachers use the above forms of assessment properly, progress can be made in learning, and goals and objectives in the child centred education can be achieved. Natural science teachers can use these assessment forms individually or in combination depending on the situation in order to get the best out of the learners, and achieve intended child centred goals and objectives. These assessments can be administered by the teacher or learners can be involved in the assessment of their work.

2.17 Child centred approach's implications to the curriculum

Donnelly and Fitzmaurice (2005) cited in Blumberg (2008) contend that, in relation to curriculum design, child centredness includes the idea that students have a choice in what to study and how to study it. In light of this assertion it is therefore of utmost importance to focus on the needs of the learners at the early stages of curriculum design. Toohey (2000) also cited in Blumberg (2008) attests that child-centred curriculum design is problem-based learning (PBL). This approach allows for choice within a programme of area that learners may study. It allows students to set some of their own learning objectives dependent on prior learning and knowledge. Problem based learning through the use of problems, issues and triggers is seen by Blumberg (2008) as encouraging learners to develop their own learning goals, thereby filling in the gaps in their knowledge or understanding. This in the process increases responsibility and accountability on the part of the learner. Blumberg (2008) goes on to say that the child centred curriculum must also address the issues of learners' rights and as well promote gender equality in education. The issue of gender equality is very essential especially in Natural Science where according to the Ministry of Basic Education (2012) there are gender disparities. Many boys are reported to be pursuing studies in Science and Mathematics than girls. If the child centred curriculum addresses these disparities then there will be equality in all spheres of education in South Africa.

Nunan (1998) asserts that, a child centred curriculum is the one that has been designed with the inputs of teachers and learners as well as other relevant stakeholders. Paul (1986) cited

in Nunan (1998) argues that every human being has a right to achieve his/her potential to the maximum, and that a child centred approach to learning helps to make this possible. Learners are therefore encouraged to participate fully in and to take full responsibility for their own learning. He goes on to say that learners should be more extroverts in expressing themselves and realise that they are important figures and actively involved not only within a lesson but also before the lesson, in planning and designing it as well as by cooperating with the teacher and their colleagues. The teacher's role in this process is sharing his learners' ideas in designing, implementing and evaluating the curriculum. Nunan (1998) proceeds to assert that in order to do this learners should be aware of learning strategies. The teacher therefore according to Nunan (1998) should:

- Provide learners with efficient learning strategies.
- Assist learners identify their own preferred ways of listening.
- Develop skills needed to negotiate the curriculum.
- Encourage learners to set their own objectives.
- Develop learners' skills in self-evaluation.

Doing so by the teacher would enable learners to develop skills that are necessary for their participation in their curriculum and teaching strategies.

2.17.1 Designing a learner centred curriculum

Estaire & Zanon (1994), Nunan (1998) argue that the learner centred curriculum can be designed following this pattern.

1. Pre-course planning procedure (needs analysis, grouping learners).
2. Planning content (setting objectives, planning and grading the content).
3. Methodology (selection of the methods).
4. Material design.
5. Evaluation.

2.17.1.1 Pre-course planning procedure (needs analysis, grouping learners).

Estaire & Zanon (1994), Nunan (1998) argue that pre-course planning procedure is the most important phase in designing the child centred curriculum, because of the fact that all other phases are dependent upon the data which will be collected at this stage. In order to design motivating, relevant content and choosing appropriate material, data about learners is a fundamental resource. Nunan (1998) continues to argue that the starting point for the learner centred curriculum development is generally the collection of various types of bibliographical data. This data according to Nunan (1998) is divided into:

- **Essential biographical information**, which can be collected at the beginning of the programme.

- **More personal information** that relate to the learners' preferences and perceptions. This information according to Nunan (1998) is collected by the teacher during the first weeks of the programme, and this helps the teacher to specify his/her content.

2.17.1.2 Planning content

Estaire & Zanon (1994) and Nunan (1998) argue that the content can be graded according to the environment of learners as well as the urgent needs of learners.

2.17.1.3 Methodology

Nunan (1998) asserts that after attaining knowledge about the learners' needs and interests, and having planned the syllabus in line with the needs and interests of learners, the next phase is to choose how it should be done. This involves agreeing on how the learning process would be.

2.17.1.4 Material Design

The material design according to Nunan (1998) supported by Hedge (2000) should reflect the real life in order for it to encourage learners to learn. He goes on to say that material design must engage the interest of the learner, and also take into account the learners' background knowledge and experiences. In order for material resources to be meaningful to learners teachers should draw them from the learners' communities.

2.17.1.5 Evaluation

Nunan (1998) argues that the innovation which is brought by the learner centred curriculum is that evaluation is not only made by the teacher at the last stage of the teaching learning process, but it has to be done at each stage of the child centred curriculum, and learners should be included in the evaluation process. Nunan (1998) and Hedge (2000) argue that, through information gathered from evaluation, decisions can be made about the subject or programme. The teacher can decide whether the subject content, teaching and learning methods are effective or not.

2.18 Resources and the child centred approach

If the child centred approach especially child centred teaching methods are to be implemented successfully a lot of resources are needed. Omosewo (2000) argues that if the library teaching method is to be used effectively, science laboratories need to be upgraded and also equipped with necessary chemicals and apparatus. On the other hand Hedge (2000) is of the opinion that the child centred approach cannot be implemented successfully if there are no resources such as text books, learning media and materials as well as qualified teachers. All this shows that in order to implement the child centred approach successfully necessary resources should be available in schools. Lemmer & Van Wyk (2010) argue that teacher training is the only tool that can transform the education system in South Africa. They contend that the teacher needs to be trained in order for him/her to be able to play his educator's role as a learning mediator, interpreter, and designer of learning programmes and materials, assessor, learning area/subject/discipline/phase specialist. In

order for the child centred approach to be successful, trained teachers and other necessary resources are needed. According to Kember & David (2009), Wright (2006) the learner centred teaching methods need a lot of resources in order for them to be a success, because in order for learners to be fully involved during lessons they need to use their own tools and apparatus in Science laboratories. Giving learners all required apparatus, materials and chemicals during a Natural Science lesson enables them to manipulate these items and gain a deeper insight into scientific experiments. Kember & David (2009) continue to assert that teachers need to be well trained and equipped with a variety of child centred teaching methods in order for them to be effective in using these methods in class. They continue to argue that if teachers are not well trained in the use of child centred teaching methods there is a danger of relapse into old traditional teaching methods that do not inspire learners in class.

2.19 Conclusion

It has been highlighted that learners benefit more if their teachers use the child centred teaching methods. Different child centred methods that teachers can choose from have been highlighted and explored in this chapter. Challenges that can be encountered when using the child centred approach have been revealed. Solutions that can be employed in order to mitigate the challenges associated with the use of the child centred approach have been suggested. It has also been highlighted that in order to successfully implement the child centred approach in teaching Natural Science qualified teachers and adequate resources are needed.

2.20 Chapter summary

The chapter began by tracing the origin and development of the child centred approach. This was done through reviewing literature on Philosophical and Psychological perspectives on the child centred approach. The chapter went on to give a comprehensive definition of the child centred approach in order to clearly highlight that the child centred approach allows the learner to play a vital role in the teaching and learning process. After the definition the major roles of the learner and the teacher in the child centred class were spelt out. The learner is the one who is more involved during the lesson, and the teacher plays the role of the facilitator. The role played by parents has also been highlighted in this chapter. The parent has been portrayed as playing a complementary role by supervising the learner when doing school work at home. The benefits and challenges associated with the use of the child centred approach were also explored in this chapter. Of interest in the chapter are the suggested child centred teaching methods that teachers can use in class. Advantages and disadvantages of using these methods have been given because they are seen as crucial in the implementation of the child centred approach in classrooms. Some of the child centred teaching methods that have been articulated involve brainstorming, laboratory methods, incorporating ICT into the classroom, debates and others. Assessment, evaluation and the child centred curriculum have been explored. The review of these revealed that learners should be involved in the assessment and evaluation of their school

work, as well as in the curriculum development process. The chapter ended by highlighting that, necessary resources and well trained teachers are needed if the child centred approach is to be implemented successfully when teaching Natural Science in schools.

2.21 The next Chapter

The next chapter articulates the type of research design as well as the methods that were used to gather data. It also highlights how data was presented and analysed. The way how ethical issues were dealt with is explained in the next chapter as well.

Chapter 3: Methodology

3 Introduction

This study is embedded on interpretivism paradigm, because it relied heavily on naturalistic methods such as observations. Natural Science teachers were observed teaching in class, and recordings were made. Based on the observations made a focus group discussion guide was developed. Hudson and Ozanne (1988) cited in Blaikie (2000) attest that an interpretivist researcher and his informants are interdependent during data collection stage. They mutually interact with each other and construct a collaborative account of perceived reality. These authorities go on to say that, the researcher remains open to new ideas throughout the study and let it develop with the help of his/her informants. In line with this assertion Angen (2000) contends that in interpretivism fostering dialogue between the researcher and respondents is critical, because it is through this dialectical process that a more informed and sophisticated understanding of the phenomenon under study can be created. In light of the above, this ideology was good for this study, because it made it possible for the researcher to observe participants teaching in class and then went on to interact with them through focus group discussions in order to get more information about what was observed. New questions that emerged from discussions generated more information about the topic.

3.1 Research Design

3.1.1 Qualitative Design

This study used qualitative design, and it took place in a natural setting in schools using a combination of observations and focus group discussions. Creswell (1994) defines qualitative research as a systematic inquiry based on interpretivism which seeks to build a holistic, largely narrative, descriptions to inform the researcher's understanding of a phenomenon. Qualitative research takes place in natural settings employing a combination of observations, interviews, and document reviews. In this study how-ever interviews were replaced by focus group discussions in order to make it possible to generate more comments, questions as well as questions and answers from respondents. Rogers (2008) is of the opinion that qualitative design is interactive in nature, and as a result allow for the use of open ended questions, in-depth and focus group discussions. He proceeds to say that, this is advantageous because it allows the researcher to change the data collection strategies by adding, refining and dropping certain techniques when necessary. This was good for this study because it gave the researcher an opportunity to observe and interview participants several times in focus group discussions in order to follow on a particular subject, clarify concepts and to check the reliability of data. Creswell (1994) attests that when using qualitative design triangulation becomes a possibility. Triangulation was essential in this study, because it enabled the researcher to compare data obtained from observations, and that obtained from focus group discussions. Teachers were observed

teaching Natural Science. After observations a focus group discussion guide was developed in order to address issues that were noted during observations in a more detailed manner.

Hancock's (2002) assertion also proves that qualitative design is appropriate for this study. He attests that qualitative research is good for finding answers to questions which begin with why? How? And in what way. This assertion is in line with the questions of this study that revolve around how. The how and which questions helped the researcher to understand how the child centred approach is applied in teaching Natural Science in Johannesburg East schools, which methods are used, why and how are these child centred approach teaching methods used.

3.2 Qualitative Research Methods

Angen (2000), Rogers (2008) tabulate qualitative research methods as observations, focus group discussions, document analysis and interviews. In this study observations and focus group discussions were used to collect data, because the study did not require any document analysis, and one on one interviews were replaced by more interactive and engaging focus group discussions. Triangulation of these methods made it possible to compare and verify data.

3.2.1 Observations

The collection of data for this study began from observing Natural Science teachers teaching in class in order to see which child centred approach teaching methods they used and how they used those methods. From what was observed a focus group discussion guide was developed in order to get more information from teachers on why they used those methods, how they prepared before using them. Welman (2005) and Johnson (1997) are of the opinion that when conducting observations the researcher has to take part in, and report on the experiences of the members of the group, community, organisations, or the people involved in a process, event, or whatever is being studied. Welman (2005) continues to assert that in participant observation we do not observe the experiences of individuals as detached outsiders, but experience them first hand as insiders. Taking this into cognisance the researcher went to the schools physically and got involved in what transpired there by observing Natural Science teachers delivering lessons in class. This enabled the researcher to have first-hand experience on which child centred approach teaching methods were used, and how they were applied by Natural Science teachers in class. Welman (2005) contends that participant observers have to assume the roles of the group members in order to personally experience what the group members are experiencing, and see things from their perspectives. In light of this, lesson observations, and focus group discussions assisted the researcher to see and understand the application of the child centred approach teaching methods from the participants' point of view and perspectives.

3.2.2 Advantages of observations to the study

Welman (2005) argues that, the flexibility of the participant observation process allows room to follow up a host of clues that the researcher supposedly noticed. In light of this it

became easy for the researcher to come up with follow up questions after observing Natural Science teachers delivering lessons in class. Participant observations also enabled the researcher to develop a holistic understanding of the application of the child centred teaching methods in teaching Natural Science in selected schools in Johannesburg East. This is supported by Kawulich (2005) who attests that participant observations afford access to the back stage culture, and allows for the richly detailed description of behaviours, intentions, situations and events as understood by participants. In conclusion observations made it possible to practically see and assess which child centred teaching methods were applied by teachers when teaching Natural Science in class, how they were applied and how learners responded or reacted to those methods in class.

3.2.3 The observation process

Patton (2002), Welman (2005) argue that in order to conduct participant observations effectively procedures should be followed. Patton(2002) proceeds to assert that, once the researcher has decided to investigate a specific group, or organisation by means of participant observations, he/she has to obtain permission of the group members or their representatives. The researcher should also disclose the objectives of the research to the group members. Doing so according to Patton (2002), Stewart & Shamdasani (1990), Welman (2005), enables the researcher to build trust and co-operation with his/her group of participants. Taking the above assertion into account, the researcher asked for permission from Gauteng Department of Education and Headmasters in selected schools to allow him to conduct research in their schools. Selected Natural Science teachers were asked to fill in consent forms containing ethical guidelines before they started participating in the study. In order to gain full cooperation and trust from Natural Science teachers the researcher explained to them the objectives and benefits of the study.

During lesson observations the researcher wrote down notes in the lesson observation guide. Those notes included the types of child centred approach teaching methods used, how they were used, which other techniques and strategies were used to support them, how learners reacted or responded to those methods. All observation notes were written while the teaching and learning activities were taking place. The observation notes apart from being used to describe the application of the child centred approach; they were also used to formulate and refine questions in the focus group discussion guide.

3.3 Focus group discussions

Johnson (1997) defines focus groups as small groups of six to ten people led through an open discussion by a skilled moderator. The group needs to be large enough to generate rich discussions, but not so large that some participants are left out. On the other hand Stewart & Shamdasani (1990) say that a focus group discussion is a good way to gather people from similar backgrounds and experiences to discuss a specific topic of interest. The group of participants is guided by a moderator/facilitator who introduces topics of discussion and helps the group to participate in a lively and natural discussion amongst

themselves. In case of this study, the researcher conducted focus group discussions with participants in places of their own choice, for example in the staff rooms, free classrooms, appropriate offices and open spaces depending on the school's set up, and the participating teachers' preferences. The purpose of doing this was to enable participants to feel free and relaxed. This enabled them to contribute freely during focus group discussions due to the relaxed and conducive atmosphere.

3.3.1 How focus group discussions were conducted

Focus group discussions that were conducted with selected Natural Science teachers were conducted according to the process and phases suggested by Stewart & Shamdasani (1990) and Welman (2005)

- First of all the researcher introduced the topic to be discussed as well as the objectives to be achieved through those discussions.
- The researcher then set ground rules, for example indicating that one participant would be allowed to speak at a time, and that participants must respect each other's views and opinions.
- The researcher also told participants the duration of the discussions.
- After that each participant made an opening statement regarding their experience about the topic to be discussed.
- The researcher guided open group discussions by asking participants questions, follow up questions, probing and the like. Participants were allowed to comment on each other's responses. They were also allowed to ask each other questions where they needed clarity or further explanations from their fellow participants.
- The researcher wrote down all the proceedings of the focus group discussions in his note book.
- Focus group discussion sessions ended with each participant giving a final statement that was not challenged.

3.3.2 Reasons for using focus groups

As earlier highlighted, focus groups were used as a follow up to observations. During participants observations in class certain activities needing further clarifications were noted down. Welman (2005) highlights that during participant observations a lot of things that need clarifications will be noted. Such clarifications there-fore can only be made by participants if a follow up focus group discussion is conducted. Stewart & Shamdasani (1990) and Welman (2005) argue that focus groups provide sources of information that can be obtained rapidly and at a low cost. This was positive to this study, because it made it possible for the researcher to gather comprehensive information from focus group discussions without spending a lot of resources such as time and money.

Another reason for using focus group discussions in this study was that, they made it possible for the researcher to clarify some aspects of the questions put to the respondents. The researcher was also able to ask the respondents to elaborate on their answers. Doing so made it possible to generate more information for the study. Higson & Smith (1995), Welman (2005) argue that focus groups are a better tool of gathering data than individual interviews that need a lot of time for the researcher to move from one interviewee to another. It is in light of this assertion that individual interviews were replaced by focus group discussions in this study.

In brief it is imperative to state that, Stewart & Shamdasani (1990) based on Wheatley & Flexner (1988), Welman (2005) contend that in order for focus group discussions to be a success the researcher should not ask more than 10-12 questions during the focus group interview. They go on to say that, in general focus group discussions should start with a general question based on the aim or main topic of the investigation, followed by specific questions. Taking this into consideration the researcher had 10 questions in his focus group guide, and he started by asking general questions about the child centred approach in order to elicit the first responses from participants for the purposes of acclimatising and putting participants on trek. After general questions, specific questions about the child centred approach teaching methods followed in order to obtain specific information about the application of the child centred approach in teaching Natural Science. Information generated from focus group discussions was written down in the researcher's note book. The researcher also highlighted key points contributed by participants during focus group discussions.

3.4 Sampling

Black (1999) defines sampling as the process of selecting participants for the study from a big population so that by studying the sample we may fairly generalize our results back to the population where they were chosen. Shamoo (2003) concurs with this assertion when he says that, sampling is selecting participants from a large group of persons identified as the population from whom data are collected. Though initially convenient sampling was used to select Johannesburg East district because of its easy access to the researcher but random sampling was used to select schools and Natural Science teachers who participated in the study. Webster's College Dictionary (2010) argues that random sampling is a method of selecting a sample from a statistical population so that every sample that could be selected has a predetermined probability of being selected. This explanation concurs with Shamoo & Resnik's (2000), MacMillan & Schumacher (2010) who attest that random sampling is a procedure for selecting subjects from a population in such a way that every member of the population has an equal chance of being selected.

The main reason for using random sampling in this study was that, as highlighted above it is appropriate when dealing with a big population; it also gives all respondents an equal opportunity of participating in the study. This notion is supported by Shamoo & Resnik

(2003) who argue that if random sampling is used in the study each member of the population or of subgroups has an equal probability of being selected as other members of the same group. Bias is avoided in random sampling, because there is a high probability that all the population characteristics will be represented in the sample. This was ideal for this study because through random sampling all the schools and Natural Science teachers had an equal chance of being selected to partake in the study, and through random sampling of schools and Natural Science teachers there was a high possibility that all the characteristics of the population was represented in the sample. This is concretised by MacMillan& Schumacher (2010) who attest that random sampling affords each member of the population or of sub-group an equal probability of being selected.

3.4.1 Sample size

A sample size according to Cresswell (2004) is the number of units, persons, specified circumstances in a population to be studied. The sample size must not be too small to support claims about a phenomenon, or too large to permit deep analysis of given data. In light of the above assertion, in this study 5 schools were randomly selected to participate in the study. Selecting 5 schools made it feasible to deal with the selected participants from those schools thoroughly in order to get the best information for the study from them. Five Natural Science teachers were randomly selected per schools in Johannesburg East to participate in the study. Two of them were observed teaching in class per school while three of them participated in focus group discussions per school. The 2 teachers who were observed per school were selected from a team of Natural Science teachers using a random selection method. Two NS teachers per school were considered sufficient and convenient for thorough lesson observations. The 2 teachers who were observed teaching automatically became part of focus group discussions because there were questions that arose when they were being observed that they were supposed to answer. Out of NS teachers who were not selected to partake in lesson observations random sampling was used to select 1 teacher to join the other 2 teachers in the focus group discussions per school. This meant that focus group discussions per school were composed of 3 NS teachers. Having 3 NS teachers in focus groups was seen as essential in stimulating detailed and informative discussions that would generate sufficient information for the study. The convenient number of teachers who were observed teaching in class and those who participated in focus group discussions made it feasible and easy to conduct lesson observations and focus group discussions.

3.5 Data collection instruments

Data was collected using observations, and focus group discussions. Selected teachers were observed teaching Natural Science in class. Recordings were made on which child centred teaching methods they used and how they used them as they discharged their lessons. After observations a focus group discussion guide was developed, refined and used. Most focus group discussion questions emerged from what was observed in class when teachers were teaching. The researcher led the proceedings in the focus group discussions by asking

participants questions and recording down their responses in his note book. Participants were given an opportunity to make comments on responses given, and as well ask the researcher and other participants questions in order to generate more information, and also have certain issues about the child centred approach clarified. The use of lesson observations made it possible for the researcher to see and experience first hand how NS is taught in Johannesburg East schools. Focus group discussions on the other hand enabled the researcher to explore a wide range of issues that relate to the use of child centred teaching methods in NS. Comprehensive information was obtained through probing, rephrasing, refining and redirecting questions during focus group discussions with NS teachers.

3.6 Validity

Juppe (2000), Patton (2002) argue that the extent to which results are consistent over time, and an accurate representation of the total population under study is referred to as reliability, and if the results of the study can be produced under similar methodology, then the research instrument is considered to be reliable. Juppe (2000), Patton (2002) continue to say that validity determines whether the research truly measures that which it was intended to measure, or how truthful the research results are. It can then be said that the definitions of reliability and validity in research reveal two strands: firstly with regard to reliability, whether the result is replicable. Secondly, with regard to validity, whether the means of measurement are accurate, and whether they are actually measuring what they are intended to measure.

In order to ensure validity and reliability in this study, all focus group discussions were conducted in English which is the language that is understood by many teachers in South Africa. The Department of Basic Education (2010) argues that the bulk of learning material in South Africa is written in English. English as well is the language that the researcher is able to understand and analyse. All focus group discussion questions were formulated after literature review and class observations in order to ensure relevance. Only relevant questions can elicit valuable and appropriate information from participants. Natural Science teachers were not assisted when answering questions during focus group discussions. Lead questions were avoided. All participants were told about the importance of the study and participating in it. Doing so reduced apathy and low participation rate during focus group discussions which could undermine the reliability and representation of the study. Questions in the focus group guide were also formulated based on the questions and aims of the study so that they could be able to elicit relevant and appropriate responses from the participants. McMillan & Schumacher (2010:330) on the other hand accentuate that validity of a qualitative study can be ascertained by using multimethod strategies that would allow triangulation in data collection and data analysis. In light of this assertion in this study a combination of observations and focus group discussions was used to collect and analyse data.

3.6.1 Trustworthiness

Gall (1996) attest that a study's trustworthiness is increased when data analysis and conclusions are triangulated, subjects' perceptions are verified in a systematic manner, and the project's data chain of evidence is established. He explains triangulation as the use of multiple data collection devices, techniques, source analysis to establish trustworthiness of findings. In this study trustworthiness of data was attained through using different techniques. First by removing researcher bias. Formulation of focus group questions was based on literature review and classroom observations rather than on the interests, beliefs and preferences of the researcher. No lead questions were asked during focus group discussions. Un-due influence on participants was avoided. This study did not happen over a day or two, but it happen over a reasonable time frame. Classroom observations were followed by focus group discussions with Natural Science teachers. This made it possible for the researcher to generate more questions and information in order to verify certain issues that emerged from observations and focus group discussions.

Patton (2002) argues that generating more questions when the study is in progress further enriches the study. The study as indicated above used class observations and focus group discussions as data collection methods. This made it possible to compare and contrast findings obtained through the use of these different data collection methods. Doing so ensured data trustworthiness in this study. Research participants in the study were also asked to check and review findings' accuracy and representativeness. To avoid losing information and details, during focus group discussions responses from participants were written down.

3.7 Data analysis

Black (1999) is of the opinion that data analysis is a process of inspecting, transforming, and modelling data with the goal of discovering useful information, suggesting conclusions, and supporting decision making. This assertion is supported by Shamoo & Resnik (2003) who attest that data analysis is a process of systematically applying statistical and logical techniques to describe and illustrate, condense, recap, and evaluate data.

In this study qualitative data analysis was used. Qualitative data analysis is explained by McMillan & Schumacher (2010) as primarily an inductive process of organising data into categories and identifying patters and relationships among the categories. This analysis of data in this study as advocated for by McMillan & Schumacher (2010) was done during data collection exercise, and after all data had been collected. The data collection and analysis in this study was treated as interwoven. These two authorities highlighted above accentuate that inductive analysis enables qualitative researchers to synthesise and make meaning from data, starting with specific data ending with categories and patterns. In this way more general themes and conclusions emerge from data rather than being imposed prior to data collection.

In this study inductive analysis was used. This analysis according to McMillan & Schumacher (2010) is a relatively systematic process of coding, categorising, and interpreting data to provide explanations of a single phenomenon of interest. The process of inductive analysis that was used to analyse data in this study is illustrated by McMillan & Schumacher (2010:368) in figure 15.1 as follows:

Field work >Recording> Data > Coding and categorising>Patterns i.e. “themes and concepts” >Narrative structure > Visual presentations.

The researcher went to the schools and collected data using instruments such as observations and focus group discussions. After the chunks of data were gathered, such data was coded and categorized into categories. Coding and categorization of data resulted in the emerging of patterns, which is the emerging of themes and concepts. After that data took the narrative structure. The narrative structure helped to explain in detail what the participants said about the child centred approach. In brief data was in this study was presented narratively followed by discourse analysis.

3.8 Ethical considerations

Vasta (1992) supported by Blaikie (2000) contends that some types of research can have psychological or emotional effects on the participants. To avoid this, ethical issues were dealt with in this study. All participants were told the objectives and requirements of the study, so that they could decide whether to participate in the study or not. A declaration form with ethical considerations was filled by all participants. In this form participants indicated their willingness to partake in the study. They also indicate whether they wanted their names to be disclosed or to remain confidential. All participants indicated that they didn't want their names and the names of their schools to be identified. Due to this fact unspecific names such as participating schools, respondents, Natural Science teachers or participants were used. This was done for the purposes of protecting participant identity.

Since this study was based on qualitative design, there was no danger of physical harm to participants since experiments that usually cause harm to participants were not conducted by the researcher. Vigilance how-ever was exercised to maximum in order to avoid any lapse that would inflict psychological or emotional harm to participants during the course of the study. From the onset participants were told that they could withdraw from the study at any time if they felt like. All participants were also told right from the beginning that participation in this study was voluntary and by choice. It was also made clear to them before they started participating that, they were not going to be paid for their contributions and participation in the study. The researcher completed a UNISA ethical clearance form and was issued with a Research ethics certificate that gave him permission to conduct the study after complying with all research ethical guidelines as per the University's standards and procedures. The researcher also applied and got permission from Gauteng Department of Education (GDE) to conduct a study in Johannesburg East schools. Permission was granted through issuing the researcher, Research approval letter by GDE. All participants

completed an informed consent form before they started participating in the study. The completion of such a form ensured informed consent on the part of participants.

3.9 Chapter Summary

In this chapter it has been categorically stated that this study was embedded on interpretivism paradigm in order to make it possible to observe Natural Science teachers teaching in class. In light of this it has also been stated that qualitative research design was used because of its suitability for the study. It has been seen suitable because it allows for the use of observations, and focus group discussions that make it possible to observe activities on the ground and interact directly with the participants. Using these instruments was seen as prudent because it made triangulation of data possible. The chapter also discussed in detail how observations and focus group discussions were administered in order to get the best information from participants. Reasons for using the above data collection instruments have also been given in detail in this chapter. It has also been highlighted in this chapter that random sampling was used in order to give all participants an equal opportunity of being selected to participate in the study. Five schools were randomly selected to participate in the study; three NS teachers per school were randomly selected to participate in focus group discussions while two NS teachers per school were randomly selected to participate in lesson observations. This sample size was seen as appropriate for the study because it made it feasible for the researcher to observe lessons and conduct focus group discussions with selected teachers in the five participating schools. A bigger sample would not make it feasible for the researcher to do a thorough collection of comprehensible data from participants. The chapter also highlighted that the removal of researcher bias during observations and focus group discussions, as well as triangulation of research instruments and data ensured reliability and validity of data. Data was presented and analysed qualitatively. After conducting field work data was recorded, coded and categorized in order to form patterns. After that, data was presented narratively followed by discourse analysis. The researcher followed all research ethical guidelines. All participants were given adequate information about the study. There was informed consent, because all participants completed the consent form that had research ethics guidelines. The researcher completed the UNISA ethical clearance form and was issued with a Research ethics certificate. The researcher also applied and got permission from Gauteng Department of Education to conduct research in Johannesburg East schools. Permission was conferred to the researcher by GDE through issuing the researcher a research approval letter. Doing so ensured that all research ethical guidelines were adhered to in this study.

3.10 The next chapter

The next chapter presents and analyses data in a narrative form. Data was grouped and presented according to the themes that emerged during the data gathering, compilation and analysis phase.

Chapter 4: Research Findings and Data Analysis

4.1 Introduction

The previous chapter outlined research design, methodology and activities that were used to collect data. This chapter presents, analyses and discusses data that was gathered from the field through lesson observations and focus group discussions. The chapter narrates and analyses what was observed happening during lesson observations. It goes on to summarise and analyse information about the child centred approach that was obtained from focus group discussions. In some cases direct responses from respondents have been tabulated and analysed. This study sought to answer the following 3 main questions: How is the child centred approach implemented in teaching Natural Science (NS) in Johannesburg East schools? Which child centred teaching methods are used in teaching Natural Science in Johannesburg East schools? How are the child centred teaching methods used in the teaching of Natural Science in Johannesburg East schools? The presentation of findings begins by showing the code names of schools, participants and respondents who participated in the study. It then goes on to highlight the NS teachers' understanding of the child centred approach, and proceeds to explore the themes that emerged during data analysis. Literature reviewed in chapter 2 has been used to repudiate or to support findings.

4.2 Presentation of findings outline

- Schools and participants code names
- NS teachers' understanding of the child centred approach

4.3 Themes

Data that was gathered from the field was analysed and from that analysis the following themes emerged.

- The application of the child centred approach in Natural Science.
- Child centred teaching methods used in teaching Natural Science.
 - Experiments.
 - Group/pair work.
 - Class activities.
 - Questioning.
 - Games.
- Challenges of using the child centred approach in Natural Science.
- Solutions to encountered challenges in the use of the child centred approach in Natural Science.
- Techniques that can be used to improve the implementation of the child centred approach in Natural Science.

4.4 Schools and participants code names

The code names of schools and participants are given on the table below.

Schools	A	B	C	D	E
NS teachers who were observed teaching	Participant 1 Participant 2	Participant 1 Participant 2	Participant 1 Participant 2	Participant 1 Participant 2	Participant 1 Participant 2
NS teachers who participated in focus groups	Respondent 1 Respondent 2 Respondent 3	Respondent 1 Respondent 2 Respondent 3	Respondent 1 Respondent 2 Respondent 3	Respondent 1 Respondent 2 Respondent 3	Respondent 1 Respondent 2 Respondent 3

4.5 NS teachers' understanding of the child centred approach

All Natural science teachers who participated in focus group discussions displayed comprehensive understanding of the child centred approach. They categorically stated that the child centred approach allows learners to take a centre stage during the lesson and become fully responsible for their own learning. The teacher only plays the role of the facilitator while at the same time taking the needs and interests of each and every child into consideration. In response to the question: Give a brief over-view of the child centred approach. Most Natural Science teachers managed to give a comprehensive over-view of the child centred approach. The first respondent, code name respondent 1 from school A attested that:

The child centred approach entails using teaching methods that focus mostly on the child. The teacher needs to understand the ability of each and every child, how each child grasps the concepts during learning sessions. NS is a doing subject, as a result learners must participate fully during lessons. They have to see and do at the same time in order for them to understand concepts better. Instead of the teacher dwelling much on theory and telling learners, he must let learners do things practically in order to allow scientific concepts to sink, because learners understand concepts better when they do things themselves.

This notion by the respondent is supported by Blumberg (2005) who attests that in a child centred classroom the teacher has to accommodate different abilities and learning styles of students. He/she must make sure that all his learners are involved during the learning process.

Respondent 1 was supported by his colleague from the same school respondent 3 who was of the opinion that:

In a child centred approach, the child is the most important part of the learning experience which produces learning more than teaching, and empowers learners to take control of learning. The child centred approach takes into consideration the learner's ability and capacity. It allows learners to build their own knowledge.

In school C respondent 1 described the child centred approach in brief as follows:

The child centred approach is more about learners learning and the teacher facilitating. Learners become the focal point in all learning situations.

Contributions by respondents show that they understood that the child centred approach pays more attention on the learner than the teacher. Its emphasis is on the fact that the learner not the teacher should be the focal point during the learning process. Authoritative sources like Mayer (1998) cited in Barbara (2007) contend that in a child centred approach learners play an active part in the learning process. Weimer (2002) on the other hand is of the opinion that, the child centred paradigm departs from traditional teaching models where the teacher dominated in class, by focusing on the learner more than teachers, and learning more than teaching, while Morrison (2010) argues that in a child centred learning the focus is on each student's interests, abilities and learning styles, placing the teacher as a facilitator of learning.

In school E respondent 2 chose to explain the concept child centred approach with an addition of some quantitative illustrations, and back up from history of South African curriculum, because She even went back to draw a parallelism between the child centred approach and the Out Comes Based Education curriculum (OBE). She argued that:

In the OBE curriculum students were supposed to be involved 75% in their learning while teachers were supposed to be involved 25%. OBE failed because teachers misconstrued the principles of the child centred approach embedded in the OBE curriculum. Instead of teachers playing their role they dumped all the work on learners in the name of child centredness. This resulted in the failure of the OBE. The National Curriculum Statement (NCS) and the Revised National Curriculum Statement (RNCS) all succeeded the OBE and failed as well because they retained the OBE texture and contents. Due to the failure of the OBE, NCS, RNCS, CAPS 2012 Documents introduced the child centred approach in a different format. CAPS 2012 documents call for learners to participate 50% in their learning, while teachers are supposed to contribute 50% as well. This is a 50-50 situation that results in a balanced teaching and learning experience.

The perusal of CAPS 2012 documents for NS revealed that the CAPS documents call for an end to rote learning and an introduction of a more interesting child centred approach without elaborating on the percentages that are supposed to be contributed by the learner or the teacher. Authorities such as Weimer (2002), Morrison (2010), Barbara (2007) and others also don't quantify how much teachers and learners are supposed to contribute

during the learning process. They only emphasise the fact that the child centred approach requires learners to be more involved in their learning without assigning percentages. The respondent was however correct to assert that the child centred approach does not mean that teachers have to dump their duties and responsibilities on learners, but they still have to play their major role as facilitators of learning. The respondent's background history about the child centred approach in different curriculums starting from OBE up to CAPS 2012 documents revealed that the respondent had a deep understanding of what the child centred approach entails, and how it was misinterpreted in different curriculums hence its failure. According to her the new CAPS 2012 documents provide a better framework for the implementation of the child centred approach than its predecessor curriculums.

4.6 The application of the child centred approach in Natural Science.

Respondents asserted that when the child centred approach is being applied in class, children are allowed to initiate their own learning by choosing activities that interest them. They work in a more independent way to discover their own potential. Learners are also given an opportunity to work in ways that complement different personal learning styles. Most respondents argued that in order for the child centred approach to be a success in schools it has to be applied in an appropriate and standard manner. In response to the question, how is the child centred approach applied in the teaching of NS in your school? Respondent 1 from school A said that, when he is applying the child centred approach in NS classes, he uses authentic learning where he uses real life applications. He believed that NS as a practical subject has many practical examples in life that are capable of making the content real and easy to relate to something in life. He used examples of Teaching Science Environment and society where learners could be asked how they save electricity and water at their homes. This respondent said that, giving learners such tasks makes the learning of NS practical and real, because it relates NS to practical issues in real life. This means that the respondent was aware that there are many practical items and practical examples that could be used as instruments of implementing the child centred approach in NS as a practical subject. The respondent went on to say that he also uses scaffolding during his lessons in order to ensure that all his learners become involved in the lesson. He saw scaffolding as an ideal technique for teaching challenging NS topics and concepts. He said:

Scaffolding enables the teacher to take a difficult topic step by step, beginning with the known moving to the unknown in order to bring all learners on board during the lesson.

These remarks prove that the teacher understood that in order to get all learners involved in the lesson he had to simplify concepts and start with what learners already knew and then moving step by step towards those concepts that are new to them. Research proves that scaffolding is a powerful technique of implementing the child centred approach, because it simplifies the concepts and enable even slow learners to be involved and participative in class. Simsons & James (2007) assert that scaffolding provides sufficient support to promote learning when concepts and skills are being first introduced to students.

Teachers help the student master a task or a concept by providing support. These supports may include the following: resources, a compelling task, templates and guides, guidance on the development of cognitive and social skills. In line with this Rosenshine & Meister (2002) assert that instructional scaffolding can be used in different contexts such as modelling tasks, giving advice, providing coaching. These supports are gradually removed as students develop autonomous learning strategies, thus promoting their own cognitive, affective, and psychomotor learning skills and knowledge. Teachers help the student master a task or a concept by providing support. The support can take many forms such as outlines, recommended documents, story boards or key questions. This proves that the NS teachers' use of scaffolding is a proper technique of applying the child centred approach in class, because it makes it possible for all learners to be involved during learning in class.

Respondent 3 and 1 from school C were of the opinion that when applying the child centred approach in NS, the teacher has to let learners do things themselves, and that could only happen if the teacher moves from the known to the unknown and from simple to complex, respondent 3 made the following remarks:

When using the child centred approach the teacher should let learners do things, and avoid doing things for them as a teacher. The teacher must not tell them answers, but must let them work out answers on their own.

Though during discussions teachers demonstrated a comprehensive understanding on how the child centred approach should be applied in NS, lesson observations how-ever proved that there was a great disparity between the statements that they made and what they practically did in class when delivering lessons. Respondent 3 was observed conducting experiments during the lesson in class. He never involved learners in the conducting of these experiments. He conducted experiments himself with learners watching. Watkins (2006) contends that since children are active participants in their own education and development, so the application of the child centred approach requires the teacher to ensure that all learners are mentally involved and physically active in learning what they need to know and do. In this case learners can only be mentally involved and physically active if they are allowed to do experiments themselves than the teacher doing experiments for them while they assume the role of spectators.

In school B respondent 2 said that when applying the child centred approach in teaching NS she uses an inclusive approach and takes into consideration that learners are not the same, but they are different and unique individuals with different personalities, character, skills, abilities and interests. This shows that teachers were aware that the child centred approach principles spelt out that learners are not supposed to be taken as uniform individuals, but they are supposed to be taken as different and unique individuals with different needs wants and preferences. Research supports their opinion; Watkins (2006) accentuates that the child centred approach must be applied in a way that will support all students in their growth and development across all domains, social, emotional, physical, linguistic, and

intellectual. The teacher has to treat every learner as a special and unique individual with different learning styles and temperament.

Other respondents highlighted a diversified way of the application of the child centred approach in NS.

When using the child centred approach I give learners research work to do, like research projects and assignments. This enables them to go and find information on their own from library and internet sources. Asserted Respondent 2 from school E

Assignments and projects require learners to go to the libraries and internet to get information on their own without the presence of the teacher. In the process of finding out information on their own they gradually become autonomous learners. Though teachers proved that they knew the value of projects and assignments in the application of the child centred approach but lesson observations revealed that all NS participants who were observed teaching did not give learners research projects and assignments. There was a gap between what was said and what was done in class. It seemed teachers knew how the child centred approach was supposed to be applied, but the gap lied on the implementation phase where by knowledge was supposed to be transformed into practice.

In school B respondent 1, 2 and 3 concurred that, when they were using the child centred approach they ensured that learners did experiments themselves and came to the conclusion on their own as opposed to the teacher teaching the conclusion. According to respondent 1,

The teacher should not teach the conclusion but he must allow the learners to come up with their own conclusion.

From all remarks that were made by respondents about the application of the child centred approach in NS, it can be said that, when applying the child centred approach NS teachers allow learners to be involved in class through using techniques among others such as scaffolding, as well as giving them assignments and projects that would enable them to research and find information on their own. By so doing learners move away from the dependence syndrome of relying too much on the teacher and become autonomous individuals capable of discovering information on their own.

4.7 Child centred teaching methods used in teaching Natural Science

Lesson observations and focus group discussions revealed that NS teachers in Johannesburg East schools use the following types of child centred teaching methods:

- Experiments.
- Group/pair work.
- Class activities.
- Questioning.

- Games.

4.7.1 Experiments

Respondents viewed the conducting of experiment as an ideal way of capturing the attention of learners in class and getting them involved in the lesson, because experiments enable them to see things practically happening. All respondents concurred that experiments are an appropriate child centred method that motivated learners in class and enhanced their engagement during lessons. They asserted that in their schools experiments were conducted by both the teacher and learners depending on the type of experiments. Respondent 1 from school D made the following remarks:

Whether the experiment would be conducted by the teacher or learners depends on the type of that particular experiment. If the experiment is safe then learners are given an opportunity to carry it out, but when the experiment is dangerous and involves chemicals such as sulphuric or nitric acids it is conducted by the teacher for the purposes of safety precautions. Some learners lack discipline, as a result it would prove to be dangerous to allow them to conduct dangerous experiments because they might end up injuring themselves or others.

Though teachers expressed their concerns about allowing learners to carry out dangerous experiments, authorities such as Stuart (2009), Omosewo (2000), McKee (2007) argue that when taught responsibility, precautionary measures and well guided learners can conduct any kind of scientific experiments without any danger of harm to themselves or others. It should also be considered that learners learn better by doing. Bloom's taxonomy especially the psychomotor domain calls for learners to be allowed to use their hands during the learning process. Conducting of experiments by teachers on behalf of learners was therefore tantamount to denying learners a chance to get involved and manipulate apparatus using their hands.

Respondent 3 from school D said that she uses experiments, because experiments promote active learning, and allow learners to explore and relate theory to practice. She concurred with respondent 1 and 2 from the same school on the fact that during experiments learners tend to see things happening practically rather than being told how things happen theoretically by the teacher. During lesson observations in school D and E it became evident that the use of experiments motivated learners and improved their participation during lessons. It was however noted during those observations that some NS teachers did not use experiments when teaching. Instead of using experiments they used theory.

4.7.1.1 How participants conducted experiments

Lesson observations afforded an opportunity to see how NS teachers used experiments as a child centred teaching method in class. They were observed conducting different types of experiments. Below is an articulation of what was observed happening. Participant 2 was observed conducting experiments in school E. He wanted learners to observe what happens

if salt, milk, and washing powder are added into different containers of water. He poured the same quantity of water into 3 different beakers. A measuring cylinder was used to measure the quantity of water. The teacher went on to add salt, milk and washing powder into 3 beakers that contained water. He used the table spoon to stir water in each beaker and then asked learners to say out what they observed after the stirring of each beaker. Learners gave their responses. Participant 2 acknowledged correct responses from learners. In laboratories stirring is usually done using a spatula not a table spoon. However it has to be noted that Blumsberg (2008) asserts that if the lesson is to be successful the teacher has to improvise. The teacher improvised with a table spoon because he didn't have a spatula to stir with. He used the table spoon after explaining to the learners that stirring was supposed to be done using a spatula. The use of a table spoon was meant to improvise since the spatula was not available.

The responses of learners to the questions of participant 2 after the experiments were conducted showed that learners learn better when they see things happening. Most learners managed to state what they observed when salt, milk and washing powder were added to water in beakers and what happened after stirring. The experiment however was going to be more interesting and effective if learners did it themselves instead of the teacher doing it for them, because Morrison (2010) and Armstrong (2012) argue that the child centred learning requires students to do things themselves, and to be actively involved in their own learning. In light of this, in this experiment the teacher and students were supposed to jointly prepare for the experiment by putting in place required apparatus and substances. Then during the experiment phase the teacher was supposed to play the role of a facilitator and let learners do the experiments themselves. These experiments could be done by learners in groups with one group using salt, and other groups using washing powder and milk. These groups through the teacher's instructions were going to record their observations during the course of experimenting and then present their findings to the whole class. Le Roux (2010) contends that, learners in class are supposed to be given an opportunity to plan for scientific investigations, use measuring instruments, conduct investigations, record findings and communicate or give a report of the findings. Omosewo (2000) on the other hand accentuates that scientific experiments become more effective and interesting if they are done by learners themselves.

In school D participant 1 was also observed conducting an experiment in the laboratory. He introduced the lesson by asking learners questions that linked with the previous topic (acid reacting with the base). The teacher used the slide projector to highlight the topic of the day and key points of what was learnt in the previous lesson. What the teacher did is recommended by Erickson (2007) where he argues that if the child centred approach is to be successful the teacher has to enable learners to connect and link concepts with what they already know.

After introducing the lesson participant 1 went on to develop it through conducting experiments. The main objective of the experiments was to enable learners to see what happened if items and substances were added to the acid. The experiments were done by the teacher and learners made their observations. After the teacher finished conducting these experiments he asked learners questions and learners responded to the questions. Most learners responded correctly while a few had challenges responding to those questions. According to Le Roux (2010) before going straight to conduct an experiment the teacher should discuss with the learners and prepare for the experiment together with them instead of doing it alone. Learners are supposed to assist the teacher to put together chemicals, apparatus, items, and recording material needed for the experiment. Stuart (2009) would rather prefer that learners conduct the experiment themselves, record observations and present findings than the teacher doing the experiment for them while they assume the role of spectators. It was however evident during the lesson that the use of experiments acted as a stimulus that made learners to be motivated throughout the lesson.

During questions and answers on what learners observed, the teacher did not write learners' responses on the board. He was supposed to write or summarise learners' correct responses on the board because, Douglas (2009) and Erickson (2007) believe that learners become more motivated and continue to be involved in learning if the teacher recognises their contributions through noting them on the board.

After lesson development the teacher did not conclude his lesson. The lesson ended abruptly without a conclusion. James (2008) supported by Lindeblad (2009) argue that teachers should conclude their lessons in order to summarise and recap the main points of the lesson and remind learners what they learnt in the lesson. A conclusion can also be used by the teacher to link the lesson with the next topic.

4.7.2 Group/Pair work

All respondents from school A, C and E, respondent 2 from school B, and respondent 1 from school D said that they use group/pair work when teaching NS, because it gives learners an opportunity to share ideas and learn from their peers. They asserted that, when using group work they combine learner of mixed abilities and give them a task to discuss followed by presentations by group representatives. They argued that doing so enables learners to learn from each other. Their argument concurs with the assertion by McInnis (2000) who accentuates that learners learn better from each other when they are given an opportunity to share information. These respondents agreed with each other that group/pair work gives an opportunity to all learners despite their personality and abilities to participate fully in class during the lesson. They also argued that group work inculcates responsibility and leadership skills in students. Respondent 2 from school C had the following to say:

In groups slow learners tend to be assisted by fast learners. When grouped with fast learners slow learners tend to gain confidence and start participating in class.

On the other hand respondent 1 from school A said:

Class activities done by learners as a group can be marked by peers in other groups. This enables cross fertilisation of ideas, and it makes learners respect each other's views and opinions.

These views and assertions are supported by Fink (2004) who asserts that group work allows learners to be active participants in their own learning, and it exposes learners to diverse ideas and approaches, and enable them to appreciate that a problem can be solved in many different ways, and it can be solved better through combined effort and ideas.

There were how-ever some respondents who thought that group work was not ideal in NS for example, respondents 1 and 3 from school B as well as respondent 2 and 3 from school E said that they don't use group/pair work when teaching NS, because it is noisy and difficult to control, while at the same time it slows down the pace and compromises syllabus coverage. They argued that, groups give an opportunity for dominant or gifted learners to bully and dominate those learners who are introverts and those who are less gifted. These arguments are supported by Fink (2004) cited in Erickson (2007) who argue that if the class is too big, it becomes problematic to use group work, because it becomes impossible to control learners and noise levels are likely to escalate, and some learners who are not confident about their abilities prefer to work independently, as a result they find group experience challenging and confronting. The majority of classes that were observed were big, and the noise levels were disturbing even if group/pair work was not used. Contrary to the assertion of Fink (2004) cited in Erickson (2007), Burdett (2003) argues that group work is an effective teaching method. In order for it to be a success in class the teacher has to prepare for it in advance. All instructions should be well explained to learners in groups before group discussions begin. Once group discussions begin the teacher has to move around monitoring progress and contributions made by each and every group member. Doing so would reduce challenges such as high noise levels, time wasting, and domination of group members by others. Taking this assertion into consideration it can be said that NS teachers who criticised the use of group work lacked exposure and did not have knowledge on how groups could be positively utilised to promote learner engagement and grasping of concepts in class. With proper planning and utilisation groups would promote teacher - learner, learner-learner interaction in class, and in the process promote the sharing of ideas amongst learners.

Despite the fact that during focus group discussions most teachers said that they used group/pair work when teaching NS, it was how-ever noted during lesson observations that not even a single teacher used group/pair work to deliver NS lessons.

4.7.3 Class activities

All the 15 respondents from the five schools said that they used class activities to a larger extent when teaching NS. Respondent 2 from school E said the following about class activities:

I use class activities as a way of assessing my learners' understanding of concepts during the lesson. I first of all teach them, and after teaching I then give them a class activity in order to check whether they understood what they were taught.

On the other hand respondent 1 from school D said that she used class activities in order to evaluate the effectiveness of her teaching methods in order to adjust or change them if necessary. She believed that excelling of learners on class activities proved effectiveness of teaching methods used to deliver the lesson, while failing of class activities by learners proved ineffectiveness of delivery methods. The views by respondents reflected what was observed in class. During lesson observations it was noted that all teachers used class activities. Teachers first of all taught learners certain topics, and after delivering those topics they proceeded to give learners class activities. After completing those activities teachers asked learners to exchange their exercise books and mark each other's work. Teachers read answers from their marking schemes in order to enable learners to mark their class mates' work.

4.7.4 Questioning

Questioning seemed to be a common method that was used by all teachers. All the 15 NS teachers who partook in focus group discussions said that questioning was one of the child centred teaching method that they used when teaching NS in class. They said that they first of all taught topics and then asked questions in order to check whether learner understood concepts and were following up the lesson. They concurred with each other that questioning helped them to monitor outcomes, learners' participation and involvement in the lesson. Respondent 1 from school E said:

Questioning if properly used allows learners to think deeply and critically in order to come up with creative solutions to the problems posed to them through questions in class.

This assertion is supported by Biggs & Tang (2007) cited in Kember et al (2009) who attest that, questioning helps learners to make inferences, think creatively, imaginatively and critically, and explore deeper levels of knowing, thinking and understanding.

Lesson observations revealed that all teachers used questioning as a child centred method when delivering lessons in class. Explanation of concepts was followed by questions. Participant 2 in school B used questioning to teach the following topic: *Separating mixtures*.

The teacher introduced the lesson by reminding learners about elements and compounds. She used job cards as well in her introduction. Learners were given job cards to analyse and pick out elements and compounds from job card A, B, C, D, and E. They were then asked

questions such as, is A an element or compound? Is B an element or a compound? This question went on up to E. It was observed that the use of job cards stimulated the interests of learners, they became more involved and participatory. The majority of them managed to respond correctly to the questions that were asked during the lesson. Clements (2013) recommends the use of charts and job cards in class when teachers are delivering lessons. He sees charts and job cards as big stimuli in the learning process. He contends that the learning media if well used improves the learners' understanding of the lesson and desire to continue learning. Job cards produced by the teacher were enough for all learners.

When the lesson reached its development phase, the teacher highlighted that items in the learners' bags were mixtures. She asked learners to separate mixtures in their school bag, and go on to sort them according to their characteristics. Learners managed to sort out those items according to their likeness, for example according to colour, size, type and the like. This showed creativity on the part of the teacher. Weimer (2002) attests that if the child centred approach is to succeed teachers need to improvise with whatever kind of items and materials they have at their disposal. By using items in the learners' bags the teacher improvised well and also managed to teach from the known to the unknown, because learners were well familiar with all the items in their school bags, so it became less of a challenge for them to separate and classify those items.

The teacher went on to use the questioning method. She asked learners how they would separate water, salt, marbles, iron fillings and leaves. Learners gave their responses. Though questioning was used well in this lesson Hadson (2008) argues that most science topics can be done better through practicals, for example in this lesson the task of separating water, salt, marbles, iron fillings and leaves was supposed to be done practically as opposed to being done through questions and answers. Learners were supposed to be the ones separating these items practically. The teacher was only supposed to give them the right apparatus and tools necessary to separate the items. Since Hadson (2008) contends that learners are creative thinkers who are capable of solving problems posed to them, learners through discussing with each other and through the support and guidance of the teacher were going to be able to use the magnet to separate iron fillings, their hands to separate marbles and leaves, a bunsen burner to separate salt from water. After doing the separation practically questions and answers and discussions could then follow.

The teacher concluded the lesson by asking learners questions on what was covered during the lesson. Most learners managed to respond correctly to the teacher's questions. She went on to give learners tasks to do as part of their homework. The teacher did well by concluding the lesson because James (2008) and Lindeblad (2009) assert that the conclusion of the lesson is of paramount importance because it wraps up and consolidates the lesson.

In school B, C, and E it was noted that all participants did not distribute their questions evenly throughout the whole class. They only concentrated on learners who raised up their hands and did not pay attention to passive learners who did not raise up their hands.

Douglas (2009) argues that questions should be evenly distributed in class and the teacher should involve all learners including those who do not raise up their hands. Though questions are an effective method of delivering a lesson, but their effectiveness could be undermined by the way how they are used. If they are not spread across the whole class there is a likelihood that some learners especially the introverts and timid ones might be left behind. In order for all learners to benefit from the questioning method the teacher should spread the questions throughout the whole class so that all learners might get involved.

4.7.5 Games

Out of all the respondents, only respondent 1 from school A asserted that he also uses games as a child centred method to deliver NS lessons. He said games help him to involve less gifted learners who could not respond to other methods such as questioning and experiments. His assertion is supported by Langford (2010) who attests that, games are an effective tool of lesson delivery, because they entertain and teach learners at the same time. If games are used to deliver lessons in class even learners who are considered to be less gifted tend to participate and understand concepts better in class.

Though the respondent spelt out during discussions the importance of using games as a teaching method in class, during lesson observations he did not use games as a tool of lesson delivery.

Focus group discussions and lesson observations proved that NS teachers in Johannesburg East schools used a limited or narrow range of child centred teaching methods. During group discussions they said that they used experiments, group/pair work, questioning, class activities, and games. Lesson observations how-ever proved that they used only 3 child centred teaching methods namely, experiments, questioning and class activities. There are many other child centred teaching methods that they could use, because Brent & Felder (2009) Smith (2011), Derting & Ebert-May (2010) argue that even in a single lesson the teacher can use more than one child centred teaching method in order to enrich the lesson and also cater for different learners who come from diverse backgrounds, and in possession of different talents, abilities, needs, interests, characters and personalities. Learners learn better when they are exposed to different methods that would address their diverse needs and interests in class.

Literature proves that there are many other dynamic and rich child centred teaching methods that NS teachers could use as well. These methods are highlighted by authorities such as Brent & Felder (2009), Anderson (2005), Armbruster (2009), McDaniel (2007), Bell (1999), McInnis (2000), Burdett (2003), Erickson (2007) and Thornburg (2005):

- brainstorming
- debates
- games
- using ICT

- case studies
- assignments
- group/pair work
- discussions
- field trips
- facilitation

Natural science teachers should capacitate and familiarise themselves with these methods so that they could use them when teaching in class. Adding all these methods on top of the 3 that they already use would enrich their knowledge base and enable them to bring a variety of the child centred teaching methods into the NS classroom. Using a variety of methods would cater for the different needs and interests of NS learners to a larger extent.

4.8 Challenges of using the child centred approach in NS

Most respondents revealed that they encounter problems when implementing the child centred approach in their schools. The major problem stemmed from the fact that NS CAPS 2012 documents do not have a child centred approach model that could act as a frame work for the implementation of the child centred approach teaching methods in NS. Other challenges highlighted pertained to the curriculum that is not child centred, inadequate staffing, inadequate resources as well as indiscipline of learners. All these were seen by respondents as inhibiting factors in the implementation of the child centred approach in NS. Respondent 1 from school C said the following about CAPS 2012 NS documents:

CAPS 2012 documents do not give specifications on which child centred teaching methods should be used, why they should be used, as well as how they are supposed to be used during NS lessons.

Respondents were of the view that lack of a child centred approach model that guides NS teachers on which methods they should use and how they are supposed to use them makes the implementation of this approach uncoordinated and a challenge. An analysis of CAPS 2012 documents revealed that in all NS strands these documents uniformly suggest the following as activities: investigations, practical work and demonstrations. There are however no further elaborations on how these investigations and practical works are to be prepared for, how they are supposed to be integrated with a wide variety of child centred teaching methods.

Respondent 1 from school C went on to contend that, lack of a standard and robust NS child centred approach model has resulted in 2 dangers. 1. NS teachers using their own teaching methods and techniques that they are comfortable with. 2. Traditional NS teachers continuing with their traditional teacher centred teaching methods such as lecture method that turn all learners into passive listeners and the teacher a giver of all information. It should be noted that traditional teaching methods that promote rote learning and

memorisation are a violation of CAPS 2012 documents principles that call for active and critical learning, rather than rote and uncritical learning of given truths.

Respondents also felt that bigger classes posed a challenge in the implementation of the child centred approach because it tended to be difficult to involve all learners in bigger classes for example when conducting experiments due to time and resource constraints. Respondent 1 from school A made the following remarks,

When teaching bigger classes, time does not allow learners to be practically involved in carrying out those experiments, because materials, apparatus and chemicals are not usually enough for all learners in a big class, as a result teachers end up doing experiments for learners while learners watch.

Respondents 1, 2 and 3 from school B concurred on the fact that in big classes it is difficult to control learners' behaviour during learning. They argued that a lot of limited contact time is wasted as teachers try to control noise and undesirable behaviour of learners in class. They asserted that in bigger classes it is too packed and impossible for the teacher to move around in class monitoring whether all learners are involved, and also maintaining discipline during the lesson.

In bigger classes it is difficult to use group/pair work because of noise levels and difficulties of moving around monitoring progress in each group, argued respondent 2 from school B.

Lesson observations revealed that some classes had larger volumes of learners to the extent that it was difficult for teachers to move around monitoring progress. It was also difficult for teachers to control noise and indiscipline during the learning process in class. Chan (2001) and Hedge (2000) attest that it is difficult to implement the child centred approach where there are limited resources and different learning cultures, coupled with a phenomenon of large classes. Chan (2001) argues that, if the classes are too large and resources are scarce, it becomes difficult for teachers to determine and fulfil the different needs of different learners in class.

It emerged during discussions that NS classes were composed of learners who possessed mixed abilities. The issue of mixed cognitive abilities was seen by respondents as posing a challenge in the implementation of the child centred approach in class.

The child centred approach calls for equal involvement and treatment of all learners in class. Treating all learners equal in class is practically problematic, because the cognitive levels of learners are vastly different. Some have extremely high cognitive levels while some have extremely low cognitive levels, asserted respondent 1 from school E.

This assertion is supported by Woolfolk (2010) who attests that according to Piaget's theory of cognitive development, children progress from one stage of cognitive development to the other at a different pace. For example some children progress from the concrete

operational stage to the formal operational stage earlier than others. This would mean that though doing the same grade these children would be having different abilities in their school work. Such a situation makes it difficult for teachers to balance the needs and interests of these children who are operating at different cognitive levels. It also becomes difficult for teachers to treat them equally since their cognitive levels would not be operating at equal levels.

Respondents concurred on the fact that, the issue of disparities on the learners' cognitive levels is further aggravated by the South African Education Policy which pushes learners to the next level even if they are not yet ready. They expressed their concerns that learners are allowed to progress even if they don't meet the standard pass mark. Respondent 3 from school A said that,

It is difficult to serve the interests of both slow and fast learners. Balancing those interests becomes difficult, because in most cases such interests tend to be parallel. If the class has extremely gifted, and extremely less gifted learners, the pace in such a class tends to be slow, and syllabus coverage tends to suffer as the teacher tries to cater for the needs of slow learners.

Respondent 2 in the same school supported this view by asserting that:

Trying to accommodate the needs and interests of slow learners tends to infringe on the needs and interests of fast learners. Serving the needs and interests of each and every learner has proven to be a big challenge in class, as a result as a teacher you end up teaching either at the pace of slow learners to the detriment of the interests and needs of fast learners, or teaching at the pace of fast learners to the detriment of the needs and interests of slow learners. Some teachers how-ever would prefer to teach at an average pace to the detriment of both slow and fast learners. Some teachers would rather teach to the pace of the majority to the detriment of the minority learners whose needs and interests would be left out.

Respondents concurred at the end that trying to treat all learners equally in class has proven to be practically impossible, because the needs and abilities as well as interests of those learners always vary. They thought that it would be effective to customise the treatment of learners depending on their needs and interests as opposed to just treating them the same and equally.

Lack of resources was another challenge that was raised by respondents. Respondents argued that in schools resources were not adequate for the implementation of the child centred teaching methods in NS classes. They highlighted shortages of qualified NS teachers, shortage of chemicals, materials and apparatus, as well as poorly equipped NS laboratories as some of the major challenges that inhibit the proper implementation or use of child centred teaching methods in NS classes. They asserted that inadequate staffing was the one

that resulted in high teacher-learner ratio. Their concern is supported by Chan (2001) who describes the child centred approach as a Western approach to teaching and learning, and may not necessarily transfer to developing countries, like for example African countries where there are limited resources and different learning cultures, coupled with a phenomenon of larger classes. He argues that if the classes are too large and resources are scarce, it becomes difficult for teachers to determine and fulfil the different needs of different learners in class. During lesson observations it became evident that bigger classes had higher noise levels and incidents of learner indiscipline. Teachers spent more time telling learners to stop making noise. It was also noted that in some schools resources were a challenge. Apparatus were not adequately stocked. In some cases teachers ended up improvising or explaining concepts theoretically due to the shortage of resources needed for practical experiments.

Lack of proper discipline by learners in schools was seen by respondents as inhibiting the implementation of the child centred teaching methods in NS. All respondents complained about poor discipline of learners. They said that in their schools learners lacked discipline, because there were no effective instruments or systems to discipline them, as a result syllabus coverage suffered, because teachers spent most of their time struggling with the ill-discipline of learners. Respondents argued that poor discipline of learners made it difficult to use child centred teaching methods such as group/pair work, because noise levels and bad behaviour would be aggravated. They feared that allowing in-disciplined learners to carry out experiments themselves would result in injuries or multiple injuries being experienced in the laboratories, because in-disciplined learners risked injuring themselves or others with chemicals and apparatus.

4.9 Solutions to encountered challenges

Respondents felt that if the challenges encountered in the implementation of the child centred approach were not solved, they were likely to hinder the whole process of implementing the child centred approach in NS. In light of this they suggested a wide range of solutions peculiar to the following challenges: bigger classes, different abilities and needs of learners, inadequate resources as well as in-discipline of learners.

4.9.1 Bigger classes

Since respondents saw bigger classes as an inconvenience in the implementation of the child centred approach, they agreed that, in order to have a proper child centred approach the number of learners per class needed to be low. Respondent 2 from school C highlighted that,

Understaffing is the one that causes big NS classes at my school, so in order to deal with the problem of understaffing that inhibits the implementation of the child centred approach; the Ministry of Basic Education has to ensure that schools are adequately staffed with qualified Natural Science teachers in order to serve NS teachers from being overloaded with too much work that makes it difficult to use the child centred teaching methods in class.

In order to deal with the issue of bigger classes respondent 1 from school C suggested that, employing assistant teachers could help to make classes smaller, making it easy or feasible for teachers to involve all learners in class, and also to take care of the learners' unique needs and interests in a NS class.

4.9.2 Different abilities of learners

Different solutions which could address different abilities and needs of learners were suggested. Respondent 3 from school E argued that it is not easy to solve this challenge, because it is difficult to teach each and every child to their abilities, needs and interests due to time and resource constraints. He suggested that teachers should therefore teach towards the majority of the class. In response to this assertion respondent 2 from school E said:

Instead of teaching towards the majority of the class who are either slow learners or fast learners the teacher has to move at an average pace while at the same time giving extra support to the weaker learners through remedial and extra contact hours, while at the same time enriching the fast learners through giving them more work that is challenging.

He argued that doing so would cater for all categories of learners in class, the slow learners, average learners and fast learners. His notion is supported by Hess (2002) who contends that, teachers should not teach to the worst or most advanced students, but they should teach to the B students. The term B according to her refers to average. Sharma (2006) has vital suggestions that can help NS teachers to deal with the issue of mixed abilities in class. She asserts that when dealing with learners who possess different abilities teachers should use a variety of teaching methods and learning media, and as well give learners personalised tasks. She argues that using different teaching methods and forms of media appeals to all learners despite their abilities and talents. She also advises teachers who teach mixed ability classes to mix abstract and concrete concepts when teaching and when giving class activities, homework and assignments in order to cater for all learners. She also urges teachers to encourage students to learn from each other. This according to her can be possible if the teacher helps learners to form study groups and encourage them to help one another with homework or studying. Finally she advises teachers to continuously evaluate learners in order to see whether there are any improvements. Evaluation results would help the teacher to map the way forward.

Respondent 1 from school D made the following remarks,

In order to solve the challenge of vast different abilities in class, the curriculum must not reduce the standards just for the sake of everyone passing. Learners must be allowed to progress to the next level only when they are ready and have met all the standards of the previous phase. This would narrow down ability disparities of learners in class making it easy to involve all of them and cater for their needs and interests which are almost similar or close to each other.

His assertion is supported by Piaget's theory of cognitive development which contends according to Woolfolk (2010) that children can grasp concepts only when they are ready to. So accelerating learners to the next grade before they could even grasp the concepts of the previous grade makes it close to impossible that they could grasp the concepts of the next higher grade when in actual fact they failed to grasp the concepts of a lower previous grade. Helping such learners would therefore become a big challenge to the teacher in class, because their level of understanding would be totally different from that of other learners.

Respondents concurred that, in order to come up with the balancing mechanism of the different needs and interests of slow and fast learners, the teacher has to encourage all learners to take full responsibility and control of their learning. If need be they could consult the teacher at their own spare time so that they could get full attention from the teacher, and have their special needs peculiar to them well addressed without any competing needs from others as the case is in classrooms. Respondent 1 from school A believed that the challenge posed by different learner abilities could be solved by using the internet. He said the following,

Teachers have to encourage learners to learn using the internet. They should give learners webpages so that learners could navigate and explore on their own. When navigating and exploring on their own learners could work and learn at their own pace and ability

His opinion is supported by Shelly, Gunter & Gunter (2010) who assert that, a computer or technological laboratory is usually a designated classroom filled with computers and technology for students to use individually or in groups. Teachers can schedule time in computer laboratories for use by learners. Respondent 1 from school A continued to argue that, in order for the use of internet by learners to be possible schools and parents need to support learners with ICT resources such as computer hardware and software as well as controlled internet connectivity. His argument again is supported by Shelly et al (2010) who is of the opinion that, in order for technology to be used in schools, schools must have well equipped computer laboratories, media centres containing computers and other relevant technologies.

On the other hand respondents 3 from school A contended that learners and parents should be educated about different learning options that are relevant to different abilities and interests of learners. He said,

Some parents force their children to do Mathematics and Science so that they could become medical doctors and engineers, yet those children are not talented in Mathematics and Science or interested in becoming medical doctors or engineers. Maybe those children might be talented in History, English Literature and aspiring to be lawyers, but parents interfere and force them to do Mathematics and Science to the detriment of their performance and future aspirations.

Most respondents agreed with him, and concurred that it is such situations that result in performance disparities in class, because all learners are gifted one way or the other, they only become less gifted if they are forced to do something that they are not gifted at. Respondents ended by agreeing with each other on the fact that, schools and parents should identify where learners' capabilities and interests lie, and then support that. They thought that if that is done gaps in performance, abilities and interests would be narrowed down in class making it easy for NS teachers to serve the interests and needs of all learners as per the requirements of the child centred approach.

4.9.3 Inadequate Resources

Different suggestions were given by respondents pertaining to the solutions to the shortage of resources. Respondent 2 from school E argued that, if there is shortage of money, schools need to prioritise on resources, and buy those equipment and chemicals that are considered to be core and essential in the learning of NS. On other equipment and items that are not considered to be core teachers can improvise. She was supported by other respondents on the point of improvising. Respondent 1 and 3 from school E supported her and asserted that, improvising is part and parcel of teaching, and it is a good strategy, because resources are always scarce in schools, therefore one way or the other in order for the child centred approach to be a success in NS, teachers need to be creative and improvise.

Respondent 1, 2 and 3 from school C argued that on issues of resources instead of leaving everything on the shoulders of the teacher in the name of improvising, schools must invest in necessary resources if the child centred approach is to be effectively implemented in NS. They argued that improvising cannot address vast demands of a NS curriculum. Schools therefore must have enough resources that support the use of child centred teaching methods. These resources according to those respondents include among others libraries, text books, chemicals and apparatus, computer laboratories designated for NS research and other scientific activities, well equipped NS laboratories in order to enable all learners to participate in experiments. Respondent 1 from school C remarked the following:

If there are no adequate resources a learner centred approach to teaching and learning becomes limited, for example when doing practicals if there are no enough apparatus for all learners to be involved physically, the teacher ends up doing everything for them. In some cases instead of conducting experiments he ends up improvising by giving theoretical explanations and examples instead of using real chemicals and apparatus.

Omosewo (2000) contends that experiments enable learners to understand science concepts better, because they tend to participate and develop critical thinking skills. This means that he sees the conducting of experiments practically as ideal than just theorising about scientific concepts.

Respondent 1, 2, and 3 all from school E were however of the opinion that improvising could solve the problem of resource shortages. They argued that, improvising was better

than failing to, because improvising in case of lack of resources goes a long way in promoting the learner centred approach in NS classes. Respondent 2 from school E had the following to say:

Laptops and slide projectors could be used to improvise if there are lack of apparatus and chemicals. Slide projectors could be used to show videos of experiments conducted in laboratories, animations and simulations of chemical reactions.

Her assertion is supported by Shelly et al (2010) who contends that the use of technology in learning can make things real, for example she believes that navigation of different websites by teachers and learners during learning can make things practical because it would enable learners to see things that are not even within the reach of their environment. This means that through technological improvisation learners could see experiments and chemical reactions practically from relevant websites even if experiments were not conducted in class. They could also see craters, volcanic eruptions, electricity generation, planetariums, river formation stages, wind erosion at the comfort of their classrooms and computer laboratories without even visiting any of those places.

In school A respondent 1 asserted that, in case of resource shortages, parents' involvement could come handy. Teachers could ask learners to bring certain resources from their homes, because some parents work in laboratories, pharmacies and firms that produce chemicals that are relevant to NS. Respondent 2 and 3 in the same school agreed that in case of resource shortages most parents could be asked to lend a helping hand where they could afford to. This is a vital point that is in line with the assertion by Marishane, Van der Merwe, Van Zyl, & Zengele (2013) who are of the opinion that, parents can serve on certain school committees dealing with the procurement of scarce learning material and educational excursion. This shows that parents can indeed play a crucial role and assist NS teachers in case of resource shortages.

4.9.4 Indiscipline of learners

All the 15 respondents from all schools A-E unanimously agreed that it is difficult to teach and to use child centred teaching methods if learners are in-disciplined and playful. Respondent 1 from school E argued that:

In order to deal with the issues of learner indiscipline, learners should be taught acceptable standard values and ethics that they are expected to abide by both at school and in communities. These values and ethics should also be embedded in the school rules and codes of conduct that all learners and parents should sign to.

In school B respondent 1, 2, and 3 attested that, the issue of learner discipline could be best dealt with through parents' involvement. They were of the opinion that parents should help teachers in disciplining their children, so that in class teachers could spend more time teaching than controlling learners and pleading with them to be quite and concentrate on

their school work. Research has proven that parents can play a positive role in handling the behaviour of their children. Hill & Taylor (2004:161-162) cited in Marishane, Van der Merwe, Van Zyl, & Zengele (2013: 232) argue that, the significance of parents involvement in schools is to promote acceptable thought patterns and behaviour of learners. Since parents involvement relates to becoming united with the school, such involvement enlarges the base that promotes acceptable behaviour among learners. This proves that informed parental involvement can improve the discipline of learners in schools and make it possible on the side of NS teachers to use child centred teaching method without any fear of being hindered by lack of discipline by learners.

4.10 Techniques that can be used to implement the child centred approach better in NS

Respondents believed that in order for the child centred approach to be implemented successfully in NS certain techniques should be employed. They suggested that, the best way of implementing the child centred teaching methods effectively in class is to make the curriculum and syllabuses child centred first, and make sure that NS curriculum and syllabuses address the needs and interests of each and every child despite their abilities and background. Respondent 1 from school A said,

The current NS curriculum dictates the pace of learning and the content of what is supposed to be learnt. This situation makes it difficult for teachers to be child centred due to the fact that the curriculum its-self is not child centred, because it dictates what must be learnt in a term or year's time, and when examinations are supposed to be written without taking into account different abilities and learning pace of learners. The curriculum just assumes that all learners would be ready at the same time for examinations at a particular predetermined time. This has resulted in many learners failing to make it in the exams, because they wouldn't be ready to sit for the exams at the time dictated to them by the curriculum.

This respondent continued to assert that:

A child centred curriculum is the one that is flexible and allows learners to learn at their own pace according to their abilities, and only sit for exams when they feel they are ready to do so.

His views on this issue are supported by Robson (2012) who asserts that in a teacher centred curriculum model students are placed in a passive role in which knowledge is given to them. The knowledge does not have meaning in the child's life and therefore does not engage the child in the act of learning. In a child centred curriculum model children take an active part in decisions about what they should learn and when they will learn it. Each child is different and has different learning needs. A chief cause of boredom and failure in schools is that children are forced to fit into the mould that is a standard curriculum. Instead of having real inputs in their own learning, children are forced to simply follow the leader. Curriculum decisions are made in a place far removed from an actual classroom and students.

In order to improve performance of learners in schools parents and children must be involved in the curriculum development process. This assertion by Robson (2012) supports respondent 1, 2 and 3 from school A who called for the abandonment of the teacher centred curriculum and an introduction of a more robust and productive learner centred curriculum.

On the other hand Respondent 1 and 2 from school D, 1, 2, and 3 from school C opposed the idea of allowing learners to sit for exams only when they are ready. They argued that, doing so would bring operational chaos as it is likely to affect the term calendar including examination time tables, because it would mean running exams throughout the year to the detriment of the operational plans and term schedules in schools. They said that the best way of trying to address the needs of all learners is for all teachers to have a work schedule of what needs to be covered within a term or a year. Then this schedule should be given to all learners and parents so that they could use it to plan their study time tables in advance. They argued that doing so would help learners to read ahead at their own pace and finish syllabuses in time. Respondents 3 from school C said,

With the use of a well detailed schedule learners would be able to go through the schedule in advance at their own pace guided by the duration of the schedule. Learners would consult their teachers if they encounter any problems or challenges. The existence of such a schedule would enable learners to research and read ahead, and get ready for exams before they are due. This would promote learner involvement as it allows learners to take full control of their own education, and move towards autonomous learning away from dependence syndrome of relying too much on their teachers.

Respondent 2 from school B on the other hand attested that, if the child centred teaching methods were to be implemented successfully in NS; the Ministry of Basic Education should invest a great deal in the discipline of learners. The facets of discipline according to her must also be enshrined into the curriculum. She argued with the support of respondent 1 and 2 in school B that, if the education system instils discipline and responsibility in learners, then learners would respect and meet deadlines of assignments and projects, do their homework in time, be responsible and study out of their own will without being forced to do so by teachers and parents, refrain from making noise in class and learn to concentrate in their school work during lessons, respect their teachers and their colleagues. These respondents were unanimous on the fact that, child centred teaching methods require discipline, cooperation, determination and responsibility on the side of learners.

Respondents also agreed with each other that, resources are a corner stone in the implementation of the child centred teaching methods in NS. They asserted that NS is a practical subject that requires learners to do thing practically. If there are no resources it becomes impossible for learners to carry out experiments personally. They argued that if there is no internet and library, it becomes difficult for learners to carry out their research or to do tasks given to them by their teachers. Respondents thought that in order to

implement the child centred approach effectively in NS there must be availability of all necessary resources like the library, well equipped NS laboratories, well-furnished standard classrooms, internet, computers, adequate staffing with qualified NS teachers, resources and support from parents to finance field trips and tours. The issue of parents supporting the learning of children through assisting with resources and financing tours and field trips is also supported by Marishane, Van der Merwe, Van Zyl, & Zengele (2013)

Respondent 3 from school D attested the following,

In order to use child centred teaching methods effectively in NS, teachers need to be well trained on how to use these methods appropriately when teaching NS, because some teachers especially traditional teachers in the system are not familiar with a variety of child centred teaching methods that can be used to teach NS.

Respondent 3 was supported by respondent 2 in the same school who said that, teachers should be trained and taught about a wide variety of child centred teaching methods, and how such methods are supposed to be used when teaching NS. He continued to suggest that the child centred approach and its application in the teaching of NS should be embedded in depth in the NS teacher training programme. Respondent 1 from school D in support of respondent 2 said,

The Ministry of Basic Education should develop a standard child centred approach model that is customised to suit the South African education system and its success in schools.

This assertion was supported by her colleagues respondent 2 and 3 from school D who believed that, if a standard child centred approach model is successfully developed for NS, it could be used to staff develop NS teachers especially traditional NS teachers on how the child centred approach should be applied in the teaching of NS in class. Respondent 2 suggested that this model could also be incorporated into the curriculum of NS teacher training programmes.

4.11 Chapter summary

The chapter presented and analysed data. Findings proved that the mostly used child centred teaching methods in Johannesburg East schools are experiments, questioning and class activities. The chapter suggested additional methods that NS teachers could use. These methods include brainstorming, games, using ICT, case studies, debates, group/pair work, assignments, discussions, field trips and facilitation. Challenges encountered in the implementation of the child centred teaching methods in NS have been presented and analysed in the chapter. These challenges range from indiscipline of learners to bigger classes and shortage of essential resources. Solutions to these problems that were suggested by respondents have also been presented and analysed in this chapter. These solutions include involving parents to discipline their children, sourcing adequate resources that are necessary for the learning of NS, improvising if need be, training and capacitating

NS teachers with skills of implementing the child centred approach, as well as designing a child centred curriculum, and a specific NS child centred approach model that would make it easy for teachers to use child centred teaching methods in NS.

4.12 The next chapter

In the next chapter conclusions were made after a brief summary of the findings. Limitations of the study were highlighted as well. Areas for further research were pinpointed. The chapter ended by laying down recommendations of the study followed by a brief summary of the study.

Chapter 5: Conclusion, limitations of the study and recommendations

5.1 Introduction

The previous chapter analysed and presented data. This chapter revisited the aim and questions of the study. Key findings of the study were summarised, and the limitations of the study spelt out. Based on the findings of the study and literature review, conclusions were drawn and recommendations made. The chapter ended by suggesting areas for further research followed by the brief summary of the study.

5.2 The aim and questions of the study

The study aimed to investigate and analyse how the child centred approach was applied in the teaching of Natural Science in Johannesburg East schools Gauteng province, in order to gain a deeper understanding of the child centred teaching methods and strategies currently used to teach NS learners. Such an understanding made it possible to come up with suggestions and recommendations on how best a wide variety of child centred teaching methods and techniques could be used when teaching NS.

The study investigated the following questions:

Question 1: How is the child centred approach implemented in teaching Natural Science in Johannesburg east schools?

Question 2: Which child centred teaching methods are used in teaching Natural Science in Johannesburg East schools?

Question 3 How are the child centred teaching methods used in teaching Natural Science in Johannesburg East schools?

5.3 Summary of findings

Data was gathered using lesson observations and focus group discussions. Randomly sampled NS teachers were observed teaching in class, after those lesson observations teachers were invited to partake in focus group discussions. From lesson observations and focus group discussions the following findings emerged:

5.4 An overview of the child centred approach

All NS teachers who participated in the study demonstrated a sound theoretical understanding of what the child centred approach entails. They categorically stated clearly that, the child centred approach allows learners to take a centre stage in their own learning. Unlike in a traditional approach where teachers dominated the lesson with learners playing a passive role, respondents said that in the child centred approach the teacher plays the role of a facilitator and allows learners to do the rest. Respondents also made it clear that in a child centred approach system the teacher has to treat all learners equally and cater for all their needs and interests despite their abilities and backgrounds.

5.5 Child centred teaching methods used

Lesson observations and focus group discussions revealed that NS teachers who participated in the study used a limited number of child centred teaching methods namely questioning, experiments, and class activities. There were however some NS teachers who still used the out dated lecture method. The lecture method was put to an end by CAPS 2012 documents that called for an end in the use of rote learning and called for the introduction of the more interesting and effective child centred approach. Using such a limited number of the child centred teaching methods to teach NS is considered inadequate, because literature review revealed a wide variety of child centred teaching methods that NS teachers could use when teaching NS. These methods among others include brainstorming, group/pair work, using ICT, case studies, assignments, discussions, debates field trips, games, and facilitation Anderson (2005), Erickson (2007), Brent & Fielder (2009).

During lesson observations it was discovered that when experiments were being conducted learners were not involved. Experiments were conducted by teachers with learners playing the role of spectators who only answered questions after the teacher had completed carrying out a particular experiment. Out of all lessons that were observed where experiments were used no single learner was involved in the preparation for and conducting of those experiments. Everything was done by teachers without any learner involvement. Langford (2010) argues that children learn better when they are involved and allowed to do things themselves than when teachers do things for them.

5.6 Challenges encountered in the use of child centred methods in NS

The challenges that are associated with the use of the child centred approach in NS were raised by respondents. Most respondents felt that one of the major challenges were big classes that made it impossible for teachers to cater for different needs, interests and abilities of each and every learner in class. They also expressed their worry that bigger classes resulted in higher levels of noise and learner indiscipline, while at the same time they made it difficult for teachers to move around in class monitoring progress during lessons. Respondents thought that understaffing and shortage of NS teachers was behind the rise of bigger classes in NS.

Respondents also felt that another major challenge in the implementation of the child centred approach in NS was the fact that CAPS 2012 documents only called for the cessation in the use of rote learning and an introduction of the more interesting and effective child centred approach. These documents however did not come up with a standard and customised child centred approach model that is supposed to be used when teaching NS. Most respondents felt that, lack of a standard and coordinated child centred approach model had resulted in NS teachers using their own teaching methods and techniques that they are comfortable with. It had also allowed traditional teachers to continue with traditional teacher centred teaching methods that promote rote learning and memorisation. Caps 2012 documents call for an end in the use of traditional teaching methods that

promote rote learning. Other challenges raised included lack of adequate NS resources such as NS computer laboratories, well equipped NS laboratories with adequate chemicals, materials and apparatus. Lack of enough chemicals and apparatus was seen by most respondents as inhibiting the use of experiments and promoting the use of theory contrary to the tenets of the child centred approach that require practical experiments to be conducted instead of theory being used to explain scientific concepts.

Respondents also highlighted that it was difficult to use the child centred approach in a class where learners possessed varying abilities, skills and talents. This according to them makes it difficult for the teacher to treat all learners equal as per the demands of the child centred approach. They believed that it is practically difficult to serve the needs and interests of both slow and fast learners equally. Another challenge that was raised by most respondents pertained to the indiscipline of learners. Respondents felt that, it was difficult to use child centred teaching methods like group work and experiments when learners lacked discipline in class. They argued that in-disciplined learners made uncontrollable noise and wasted more time quarrelling when group work was used, and in-disciplined learners according to respondents risked injuring them-selves and others if they were to be allowed to conduct NS experiments themselves.

Respondents were also of the opinion that another big challenge that inhibited the implementation of the child centred approach in NS was that, the NS curriculum was not child centred, because it dictated to learners what to learn and when to learn it, as well as when learners should write exams. They argued that, the curriculum dictated the pace for the child without considering whether the child was comfortable with that pace, or was ready to learn certain concepts and topics at the time dictated by the curriculum. They also contended that, the curriculum did not care or considered whether the child was ready to write the exams at a prescribed period or not.

5.7 Solutions to encountered challenges

During discussions respondents suggested solutions to the challenges encountered in the implementation of the child centred approach in NS. On bigger classes they suggested that the Ministry of Basic Education should adequately staff schools with qualified NS teachers, while at the same time employing assistant teachers could help to reduce the burden of overloading NS teachers with large volumes of learners that made the use of child centred teaching methods difficult or impossible. On different abilities and talents possessed by learners, respondents suggested that, among other techniques NS teachers should give remedial lessons to slow learners while at the same time enriching fast learners by giving them challenging work. They suggested that ability disparities could be remedied by helping learners to learn through the internet at their own pace and only come to the teacher to consult. Respondents argued that teachers should give learners websites where they could access information. Doing so according to them would enable learners to go to the internet

and access information on their own using their own pace without competing with anyone. Learners could then consult their teachers either on line or physically if need arises.

On the issue of resources, most respondents believed that teachers should improvise one way or the other through for example using the slide projector to simulate chemical reactions, or to show how certain experiments are conducted and how the end results look like. This according to respondents could be done in case of shortages of chemicals, materials and apparatus. Some respondents suggested that in order to deal with the challenges of resource shortages parents could be involved. Parents could be asked to provide those resources or to facilitate their economic procurement especially those parents who work in firms and industries that produce relevant scientific apparatus and chemicals.

Pertaining to the lack of discipline by learners, respondents felt that parents involvement could remedy the situation. They said that, parents could be involved in disciplining and counselling their children, while at the same time schools should enact proper codes of conduct governing the behaviour of learners. After the enactment of such codes of conduct parents and learners should sign them as a commitment that they would abide by them. Other respondents asserted that learner discipline could be easily dealt with in schools if issues of respect and responsibility are embedded in the school curriculum in order to orient learners at a tender age.

On the issue of the NS curriculum that is not child centred, respondents argued that, a child centred NS curriculum needs to be designed first in order to ensure successful implementation of the child centred approach in NS. They asserted that, after the designing of the child centred curriculum then an appropriate, standard and customised child centred approach model should be developed to implement the NS curriculum. They felt that after the development of a standard child centred approach model for NS subject, then that particular model could be incorporated into the NS teacher training programme curriculum, and also used to staff develop or in-service NS teachers who are already in the field especially traditional NS teachers who are still using traditional teaching methods, due to the fact that they are not familiar with child centred teaching methods.

5.8 Challenges and Limitations of the Study

Though the study was well prepared for, there were how-ever some challenges that were encountered on the way. Focus group discussions were held after school hours in order to avoid disrupting the flow of lessons in schools. During after school hours some NS teachers wanted to rush home especially those staying away from school, and were afraid of traffic jam. This resulted in certain appointments being postponed. Some schools had scheduled activities during after school hours. This made it difficult for NS teachers to attend focus group discussions. In such cases appointments were also postponed to later dates. Such postponements posed a challenge on the researcher's time and financial budgets. The study was only limited to Johannesburg East schools in Gauteng province. This means that other

schools in Gauteng province that are located outside Johannesburg East were not afforded an opportunity to participate in the study.

5.9 Conclusion

Based on research findings and literature review, it was concluded that NS teachers in Johannesburg East schools used a limited or narrow range of child centred teaching methods namely experiments, questioning, as well as class activities. Learners were not involved in the conducting of experiments. Teachers conducted experiments while learners played the role of spectators. Some NS teachers still used the lecture method to a greater extent. CAPS 2012 documents calls for an end in the use of traditional methods such as lecture methods, because they promote more boring and uninspiring rote learning as opposed to the more interesting and creative child centred approach. Literature review revealed that there are a wide variety of child centred teaching methods that NS teachers could use than just using three methods. These methods according to Anderson (2005), Erickson (2007), Brent & Fielder (2009) include among others brainstorming, group/pair work, games, debates, discussions, using ICT, case studies, and assignments, field trips, and facilitation.

The Ministry of Basic Education does not have a standard and coordinated NS child centred approach model that is supposed to guide NS teachers in the implementation of the child centred approach. There is no standard child centred approach model that states which child centred teaching methods should be used, how they are supposed to be used, why should they be used in NS, what challenges are associated with their use, and how are NS teachers supposed to counter or deal with those challenges. Lack of such a standard model has resulted in NS teachers using only a narrow range of child centred teaching methods that they are comfortable with, while some have remained still using the obsolete traditional methods such as the lecture method that are contrary to the principles of CAPS 2012 documents that explicitly call for an end in the use of methods that promote rote learning.

In-discipline of learners, understaffing, big classes, and inadequate NS resources such as lack of NS labs fully equipped with necessary chemicals, apparatus and computers are all inhibiting factors in the implementation of the child centred approach in NS. Different abilities of learners and the NS curriculum that is not child centred due to the fact that it dictates the pace to the learner, and also dictates what is supposed to be learnt, when it should be learnt, and when must learners write exam without considering their readiness are all the factors that make it impossible for NS teachers in Johannesburg East schools to implement the child centred approach successfully in NS.

5.10 Recommendations

Based on the findings, conclusions, and literature review the following proposals were made to the stakeholder community that involves the Ministry of Basic Education, schools, teacher training institutions, NS Heads of Departments (HODs), and NS teachers.

Ministry of Basic Education

- In order to avoid uncoordinated implementation of the child centred approach in NS, the Ministry of Basic Education should develop a standard and customised child centred approach model that should be used in NS. Such a model among other things should elucidate how a wide range of child centred teaching methods should be used individually or integrative to teach NS. The model should also spell out how challenges associated with the use of the child centred approach should be mitigated.
- After developing a child centred approach model NS teachers should be in serviced by the Ministry using that particular model. The model should also be incorporated into the NS teacher training programme curriculum.
- The Ministry of Basic Education should design a child centred curriculum capable of taking care of different needs, abilities, talents, and interests of each and every learner as opposed to the current curriculum that dictates the content and pace to learners.
- The Ministry of Basic Education should sign a Memorandum of Understanding (MOU) with the Ministry of Higher Education expediting the funding and training of Science teachers in order to avert the shortage of qualified NS teachers which result in bigger classes, and the use of temporary teachers in NS.
- The Ministry of Basic Education, schools and parents must invest in the discipline of learners, because it is difficult for NS teachers to use child centred teaching methods such as group/pair work and experiments when learners are in-disciplined and risk injuring themselves and others with chemicals and apparatus.
- NS teachers should be continuously in-serviced by the Ministry on how to balance the needs and interests of learners with different abilities, talents and backgrounds, and also on how to use child centred teaching methods to teach NS in an environment where there are minimal resources.

Schools

- Schools should equip NS labs with adequate chemicals, apparatus, materials and any other essential infrastructure that is necessary for the security and learning of NS.
- Schools should establish well equipped and up to date computer laboratories with modern computer hardware and software, and designate them exclusively to NS subject.
- Schools should draft a proper model and responsibility matrix governing parents involvement in schools. Roles and responsibilities of parents in the implementation of the child centred approach in NS should be well spelt out in that model in order to avoid haphazard involvement of parents in the school affairs.
- Natural science teachers should be in-serviced and staff developed by schools and familiarised with a wide variety of child centred teaching methods, and how these

methods are supposed to be used to teach different topics in NS. Doing so would enable NS teachers to use more child centred methods beyond experiments, class activities, and questioning.

- Continuous special in-service programmes should be developed by schools for traditional teachers who were never or had little orientation on the child centred approach paradigm.

Teacher training institutions

- Teacher training institutions should collaborate with the Ministry of Basic Education and develop a NS child centred approach model and incorporate such a model into the teacher training programme curriculum.

NS HODs

- NS HODs should collaborate with HODs from sister and cluster schools and share information on how a wide variety of child centred approach teaching methods and strategies could be applied in NS.
- NS HODs should staff develop their teachers on how to use a wide range of child centred approach teaching methods, strategies and principles.

NS teachers

NS teachers should invest in self or personal development and capacitate themselves with skills and knowledge of using a wide variety of child centred teaching methods strategies and principles.

5.11 Areas for further research

Research in the following areas could improve and enrich the implementation of the child centred approach in NS:

- ❖ Designing and implementing a child centred NS curriculum.
- ❖ Designing a standard and customised child centred approach model for NS.
- ❖ Developing and implementing a Quality Management System (QMS) in NS.

5.12 Summary of the study

The study investigated how the child centred approach is applied in teaching Natural Science (NS) in Johannesburg East schools. Data was collected through lesson observations and focus group discussions. Data presentation and analysis revealed that NS teachers used a limited range of child centred teaching methods. Some still used the out-dated lecture method. Literature review revealed numerous child centred teaching methods that NS teachers could use. Some of these methods are brainstorming, discussions, games, field trips, using ICT, debates and facilitation. The study also revealed that challenges such as the teacher centred curriculum, inadequate NS resources, and bigger classes inhibit the implementation of the child centred approach in NS. The study recommended that, in order

for the child centred approach to be implemented successfully the Ministry of Basic Education should develop a NS child centred approach model and curriculum, staff develop NS teachers on child centred teaching methods, and capacitate schools with necessary NS resources.

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Appendices

Appendix: A



Research Ethics Clearance Certificate

This is to certify that the application for ethical clearance submitted by

B Madlela [48031232]

for a M Ed study entitled

**An investigation on how the child centred approach is applied in the teaching of
Natural Science in Johannesburg East schools**

has met the ethical requirements as specified by the University of South Africa
College of Education Research Ethics Committee. This certificate is valid for two
years from the date of issue.

A handwritten signature in black ink, appearing to read 'KP Dzimbo'.

Prof KP Dzimbo
Executive Dean : CEDU

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

Dr M Claassens
CEDU REC (Chairperson)
mcdtc@netactive.co.za

Reference number: 2014 AUGUST /48031232/MC

19 AUGUST 2014

Appendix: B



GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no: D2015 / 133

GDE RESEARCH APPROVAL LETTER

Date:	10 June 2014
Validity of Research Approval:	10 June 2014 to 3 October 2014
Name of Researcher:	Madlela B.
Address of Researcher:	Institute of Development Management P.O. Box 1534 Mbabane Swaziland
Telephone Number:	002 687 6435 185
Email address:	benkosimadlela@yahoo.com
Research Topic:	An investigation on how the child centred approach is applied in teaching Natural Science in District 9 schools; Johannesburg East
Number and type of schools:	FIVE Secondary Schools
District/s/HO	Johannesburg East

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

Making education a societal priority

Office of the Director: Knowledge Management and Research

9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0508
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

- The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.
- The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.
- A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.
- A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.
- The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.
- Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
- Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.
- Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
- It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.
- The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
- The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.
- On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.
- The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.
- Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

David Makhado
.....
Dr David Makhado

Director: Education Research and Knowledge Management

DATE: 2014/06/11
.....

Making education a societal priority

Office of the Director: Knowledge Management and Research

9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0508
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

Appendix C

Ethics Permission Request Letter

S.M Locksmith
No 98 Banket and Pretoria Street.
Shop No 5
Hillbrow
2001
03 May 2014

Office of the Director: Knowledge Management and Research
Gauteng Department of Education
9th Floor, 111 Commissioner Street,
P.O Box 7710
Johannesburg

Dear Sir/Madam

RE: Request for authorization to conduct a research study in your schools

I Benkosi Madlela a registered Masters' student at the University of South Africa (UNISA), hereby apply to be granted permission to conduct a research study in your schools. A research study is a requirement to complete and obtain my Masters' Degree. The title of my intended study is:

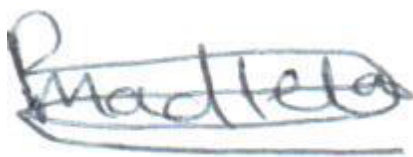
An investigation on how the child centred approach is applied in the teaching of Natural Science in Johannesburg East schools

The purpose of this study is to explore and describe the types of child centred teaching methods that are used by Natural Science teachers, and how they use these methods in class. Such an exploration will make it possible to understand how child centred teaching method are used to teach Natural Science. This will make it possible to come up with recommendation on how best a wide range of child centred teaching methods can be used to teach Natural Science in schools. Natural Science teachers will be randomly selected and asked to volunteer to participate in the study. They will be allowed to withdraw at any stage of the study should they feel like without any consequences for them. We foresee no risks if they decide to participate in this study. All data will be kept confidential and no information will be linked to a specific School or Natural Science teacher. Names of participating schools and teachers will not be disclosed, they will remain anonymous. Code names will be used in order to protect the identity of participating schools and Natural science teachers. Natural Science teachers who will participate in the study will be requested to participate in writing,

and will sign an informed consent form before participating in the study. Natural Science teachers who will participate will be observed twice teaching in class, and after that they will participate once in focus group discussions. Focus group discussions will comprise of 3-5 Natural Science teachers. Focus group discussions will be done in the school premises for the convenience of teachers. Proceedings of focus group discussions will be recorded using the voice recorder, while at the same time key points will be jotted down. Information obtained during discussions will be kept confidential, and will not be discussed anywhere after the group disbands. Lesson observations will last for the duration of the standard lesson per teacher. This will enable the researcher to see how the whole lesson is conducted right from the introduction up to the conclusion. Information obtained during lesson observations will be kept confidential. Focus group discussions will take two hours per session, and they will be conducted after hours in order to avoid disrupting lessons. All this will be done voluntarily by these teachers. Schools and Natural Science teachers who will participate in this study will be allowed to have access to the final report. As per the Gauteng Department of Education Research (GDE) Protocol, and a Guide for Conducting Research in GDE Institutions, after compiling the dissertation the researcher will complete the Research Report summary for GDE: Ref. No D2015/ and hand it to GDE together with the hard and soft copies of the dissertation. A brief presentation of the finding will be done to the GDE.

Permission to conduct this study will also be obtained from UNISA, CEDU Research Ethics Committee in order to ensure that this study will be conducted in an ethical manner. Given below are my contact details where I can be contacted at any time if need arises. Find attached my Research Proposal.

Yours Faithfully

A handwritten signature in blue ink that reads "Benkosi Madlela". The signature is written in a cursive style and is underlined with a single horizontal line.

Researcher: Benkosi Madlela

[Tel: +268 76435185](tel:+26876435185)

E-mail address: benkosimadlela@yahoo.com

Supervisor: Dr P.J Heeralal (UNISA)

Tel: 0837971029

E-mail address: Heerapj@unisa.ac.za

Appendix: D

CONSENT FORM

Consent to Participate in a Research

Title: An investigation on how the child centred approach is applied in the teaching of Natural Science in Johannesburg East schools.

Researcher: Benkosi Madlela

Supervisor: Dr P.J Heeralal (UNISA) Tel: 0837971029

E-mail address: Heerapj@unisa.ac.za

Dear Natural Science teacher

I Benkosi Madlela a registered Masters' student at the University of South Africa (UNISA), hereby kindly invite you to volunteer to participate in a research study. A research study is a requirement to complete and obtain my Masters' Degree. You have been randomly selected to take part in this study because you form part of the team of Natural Science teachers in Johannesburg East schools. The purpose of the study is to explore and describe the child centred teaching methods that are used by Natural Science teachers in class, in order to gain deeper understanding of the child centred teaching methods that are used to teach Natural Science. This will make it possible to come up with recommendations on how a wide range of child centred teaching methods can be utilised in teaching Natural Science in schools.

We foresee no risks if you decide to participate in this study. You will be observed twice teaching Natural Science in class and after that you will be asked to participate once in focus group discussions. You will be expected to respond to questions from the moderator and colleagues. You will be expected as well to comment, ask the moderator and colleagues questions during the course of discussions. Participation in the focus groups will take about one to two hours. The focus group discussions will be conducted after work hours at your work station at the time convenient to all participants. These discussions will take 1-2 hours per session. Please feel free to ask any questions you may have about the study or about

your rights as a participant. You are free to contact Benkosi Madlela on benkosimadlela@yahoo.com or on 0026876435185 at any time.

It is important for you to know that your participation is entirely voluntary. You may decide not to take part in or to withdraw from the study if you feel like at any time without any penalty. The focus group discussions will be tape recorded; a verbatim transcription will be done as well during the course of discussions. All information obtained from lesson observations and focus group discussions will be kept confidential, it won't be discussed anywhere after the group disbands, data will be coded and will not be linked to your name. Your identity will not be revealed while the study is being conducted or when the study is reported or published. Participating in this study is purely voluntary; you will not be paid or given any gift for your participation. After the study has been finalised you will be allowed to have access to the final report. Permission to conduct the study in your school has been granted by the Gauteng Department of Education (GDE), and the GDE research approval letter has been given to the Principal and the Chairperson of your school governing board. Permission to conduct this study has also been sought from UNISA CEDU Research Ethics Committee.

I have read and understood this consent form and voluntarily consent to participate in this study.

Participant's name _____

Participant's signature _____ Date _____

I have explained this study to the above participant and have sought his/her understanding for informed consent. After this form has been signed I will give the participant a copy that he/she will keep.

Interviewer's signature _____ Date _____

Appendix: E

FOCUS GROUP GUIDE

Title: An investigation on how the child centred approach is applied in the teaching of Natural Science in Johannesburg East schools

INTRODUCTION

The facilitator will be conducting a focus group discussion with the Natural Science teachers in Johannesburg East schools. Discussions will be based on questions based on the child centred teaching methods that are used in teaching Natural science and how such methods are applied in class while teaching Natural Science. With the compiled data and feedback, the researcher will make recommendations on a wide range of child centred teaching methods that can be utilised to teach Natural Science in schools.

Questions of the study

The main questions of the study are:

Question 1 How is the child centred approach implemented in teaching Natural Science in Johannesburg East schools?

Question 2 Which child centred teaching methods are used in teaching Natural Science in Johannesburg East schools?

Question 3 How are child centred teaching methods used in teaching Natural Science in Johannesburg East schools?

Target Audience

The target group are Natural Science teachers in Johannesburg East schools.

Conclusion

The facilitator will conclude by asking the following questions from the participants.

- Is there anything missed out that you would like to mention?
- What are the most important points that we have discussed?
- Are there any additional questions arising from what has been discussed?

Timing

The focus group discussion will take about two hours. The following table shows the topics to be covered and time to be spent on them.

Table 1

Topic	Minutes
Introduction and welcome focus group participants	15
Explaining the purpose of the focus group discussion	15
<p>Main discussions based on the following questions:</p> <ul style="list-style-type: none"> ▪ Give a brief definition of the child centres approach. ▪ How is the child centred approach applied in the teaching of Natural Science in your school? ▪ Which child centred teaching methods do you use when teaching Natural Science in class? Why? ▪ How do you use these child centred methods in class? ▪ Are parents supposed to be involved when using child centred methods? Why? ▪ Are there any challenges that you encounter when using child centred teaching methods in a Natural Science class? ▪ What measures have you taken or think need to be taken in order to solve these challenges? ▪ What do you think needs to be done in order to help Natural Science teachers to implement child centred teaching methods more effectively in class? 	50
Focus group discussions based on arising questions and issues raised by participants.	30
Concluding remarks and statements.	10
Total	120

Appendix: F

Focus Group Checklist

The facilitator should remember to bring the following:

- Pens
- A notepad with sufficient paper for taking notes during the entire focus group
- A flip chart
- White Board Markers.
- Stick staff.
- Recording equipment:
 - Tape recorder
 - Extra tape recorder
 - Extension cord
 - Batteries as a backup system
- Consent forms (enough copies for all participants)
- Focus group guide
- Note taking form

Things to remember when conducting the focus group discussion:

- The facilitator should be very familiar with the primary research objectives of the study
- Very familiar with the focus group guide
- Review this checklist
- Arrive at the focus group location a few minutes before participants to organize the room and materials
- Welcome focus group participants
- Introduce himself, note takers and other observers
- Explain, in a general and brief way, the purpose of the focus group and how information collected during focus groups will be used and toward what goal
- Explain participants' rights and what participating in the focus group will entail
- Remind participants of the duration of the focus group discussion, emphasising the importance of their participation during entire discussions
- Let people know where the closest restroom facilities are located
- At the end of the focus group, give participants contact information where they can contact him when they have questions
- Complete the Debrief Discussion Tool with the note taker
- Ensure that tapes are labelled appropriately
- Ensure that hand-written notes, tapes, the debrief summary form, and consent forms are returned to the designated person

Appendix: G
FOCUS GROUP NOTES TAKING FORM

Title: An investigation on how the child centred approach is applied in the teaching of Natural Science in Johannesburg East schools.

This template will guide the note taker in capturing the key areas that the researcher seeks to understand

Instructions:

Please use this form to record the proceedings of the focus group. Notes should be extensive and accurately reflect the content of the discussion, as well as any salient observations of nonverbal behaviour, such as facial expressions, hand movements, group dynamics, etc.

Date of Focus Group Discussion: _____

Location of Focus Group Discussions: _____

Name of Note Taker: _____

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Appendix: H

Observation guide

Title: An investigation on how the child centred approach is applied in the teaching of Natural Science in Johannesburg East schools.

INTRODUCTION

The researcher will observe Natural Science teachers teaching in class, and record the types of teaching methods that they use to deliver their lessons and how they use such methods in the different phases of the lesson. This will make him understand the types of child centred teaching methods that are used to teach Natural Science and how such methods are used by Natural Science teachers in class. Such an understanding will make it possible to come up with recommendations on how a wide range of child centred teaching methods can be used to teach Natural Science in schools. During the course of the lesson comments will be written down. Some questions that will be asked during focus group discussions will be written down during these lesson observations.

Subject

Date:

Class

Topic.....

Duration.....

Lesson

objectives.....
.....
.....

Introduction

Methods used.....

How they were used.....

Lesson development

Methods used

How they were used.....

Learners' response

Lesson conclusion.....

.....

Researcher's comments.....

.....

.....

Researcher's Signature.....

Date.....

Participant's Signature.....

Date.....

