A STUDY OF THE INFLUENCE OF COMMON TASKS FOR ASSESSMENT ON THE PEDAGOGICAL PRACTICES OF GRADE NINE NATURAL SCIENCE TEACHERS

By

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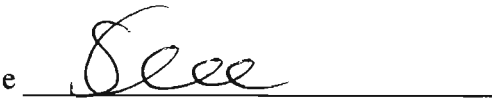
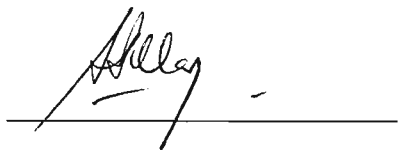
DECLARATION

This study represents the original work done by the author (the undersigned) and has not be submitted in any form for any degree or diploma to any tertiary institution. Where the work of oth authors is used in the text, it is duly acknowledged.

Siphesihle Cele 

SUPERVISION

This study was supervised by me, Dr. Alan Pillay, of University of KwaZulu-Natal in the Faculty of Education.

Signature: 

ABSTRACT

This study explores the influence of Common Tasks for Assessment (CTAs) on the pedagogical practices of Grade 9 Natural Science teachers. CTAs are assessment tasks set by the National Department of Education and administered as an external examination in Grade 9 classes (exit level I) in South Africa. The pedagogical practices in this case refer to the strategies the teachers employ in their practices and the work they give to the learners. The key research questions are:

1. What are the teachers' views on the CTAs as teaching and learning tools?

2. What influence do CTAs have on the pedagogical practices of Grade 9 Natural Science teachers?

I followed an interpretive paradigm in my research. I used both quantitative and qualitative approaches in my study, so I used triangulation. This study involves survey research hence survey strategies are used. Initially quantitative approach are used and then followed up by qualitative approach. Questionnaires are used to facilitate the quantitative approach and interviews are used for qualitative approach. Thirty two participants responded positively to questionnaires, and five teachers were interviewed in this research. Questionnaires were set to determine the influence of CTAs on teachers' pedagogical practices and interviews were set to validate or corroborate what transpired in questionnaires and also to find the views of teachers on CTAs.

The analysis of the questionnaires showed that about 84% of teachers were influenced by CTAs. It also revealed that *group work, problem solving, pupils' presentations, self assessment, practical work and investigations* are the categories of work that are influenced the most by CTAs. The analysis of the interviews also had the same findings. The interviews also revealed that the *inquiry learning, self discovery and question and answer* are teaching methods promoted by CTAs. The research also found that some teachers view CTAs as good tools for improving teaching and learning in South African schools because they promote critical thinking and problem solving.

After analyzing the results I came to the conclusion that CTAs promote learner-centred pedagogical practices in teachers. They also accentuate the strategies that are associated with critical thinking and

problem solving. I also concluded that CTAs tend to influence the teachers towards attaining quality education because leaner-centred practices and problem solving are the key components of quality education.

This study has also found that teachers are not happy with the manner in which CTAs are administered. A possible further study therefore could be that of investigating the ways in which the administration of CTAs can be improved so that they can be more beneficial to teaching and learning in South Africa.

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Glossary of Acronyms and Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ASs	Assessment Standards
CASS	Continuous Assessment
CAT	Classroom Assessment Techniques
COs	Critical Outcomes
CTAs	Common Tasks for Assessment
DOs	Developmental Outcomes
DoE	Department of Education
FET	Further Education and Training
GET	General Education and Training
GETC	General Education and Training Certificate
HIV	Human Immune Virus
HOD	Head of Department
LOs	Learning Outcomes
NCS	National Curriculum Statement
NSLA	Natural Science Learning Area
OBA	Outcomes-Based Assessment
OBE	Outcomes-Based Education
PPN	Post Provisioning Norm
QTM	Quality Teaching Model
RSA	Republic of South Africa
RNCS	Revise National Curriculum Statement
SA	South Africa
SBA	School-Based Assessment
SEM	Senior Education Manager
SGB	School Governing Body
UMALUSI	The Council for General and Further Education and Training Quality Assurance in the Republic of South Africa
USA	United States of America

CHAPTER 1

INTRODUCTORY PERSPECTIVES

This study is based on the influence of Common Tasks for Assessment (CTAs) on the pedagogical practices of Grade 9 Natural Science teachers in South Africa. In this work I endeavoured to find the teachers' views on CTAs and to determine what influence do CTAs have on the pedagogical practices of Grade 9 Natural Science teachers. The pedagogical practices in this case being the strategies that the teachers employ in their teaching practice and the work they give to learners. These include the teaching methods they use and the work they give to learners. Research has shown that most teachers respond positively to curriculum innovations (Scholtz, Waaston, and Amosun, 2004). CTAs can be viewed as curriculum innovation because they present assessment in an unusual way. In CTAs assessment takes a longer period than usual tests or exams. Each CTA exam paper takes about 12 hours. If curriculum innovation influences teachers' practices and CTAs fall under curriculum innovation, CTAs are therefore expected to influence the pedagogical practices of teachers. CTAs were first implemented in 2002 and were made compulsory to all South African schools in 2003 (Poliah, 2003).

My main aim in this study is to find how teachers view CTAs and also determine how CTAs influence pedagogical practices of Grade 9 Natural Science teachers. There is a need for this study because to my knowledge, research related to my aim has not been conducted. In this chapter I will outline the purpose of CTAs in the South African context in relation to the introduction and implementation of OBE. I will also relate CTAs to the evaluation of outcomes and finally locate CTAs in the purpose and focus of my study in the South African context. I have also chosen to present a section on OBE and the National Curriculum Statement (NCS) which culminated from the Revised National Curriculum Statement (RNCS) in this chapter to provide a background to support the need for investigating CTAs in relation to a competency led curriculum.

1.1 What Are CTAs?

The Common Tasks for Assessment (CTAs) are assessment tasks that are set by the National Department of Education in South Africa and are brought to schools towards the end of the academic year to be administered in Grade 9 classes. CTAs form an external component of Grade 9 assessment. They form 25% of learners' total assessment (Western Cape Education Department, 2002). The Department of Education introduced CTAs after introducing Outcomes-Based Education (OBE) in South African schools. CTAs engage an integrated assessment strategy, i.e., they assess a number of related learning outcomes within a single activity, and also engage a number of different assessment methods. Grade 9 is viewed as the exit level for learners in the GET education band.

1.2 The Features of CTAs

The Department of Education (DoE) has set the following features for CTAs:

1. The CTAs will have two sections, Section A and Section B.
2. Twelve hours will be allocated per CTA, 10 hours for section A and 2 hours for section B.
3. Section A makes up 60 % of the CTA mark and section B makes up 40 % of the CTA mark.
4. Section B is expected to be strictly controlled and should not be more than 2 hours (Department of Education, 2002 b, p. 13)

The CTAs activities are classified into two sections, Sections A and B as explained in the policy document referred to as Curriculum 2005 Assessment Guidelines, Natural Science, Senior Phase (Department of Education, 2002b).

Section A: This section consists of activities that could lend themselves to both group and individual assessment. Individual assessment

could be in the form of presentations, exercises and report writing. Different assessment strategies should be employed in this section.

Section B: This section reflects the transfer of skills from Section A and is in the form of paper and pencil assessment.
(Western Cape Education Department, 2002, p. 5)

CTAs are arranged in such a way that they are a process and not an event, hence they are administered over a long period of time as compared to normal examinations. Each CTA examination paper is written over a period of 12 hours and is spread over two to three weeks. The assessment policy suggests that the CTAs should be infused into the routine schedule of the school. CTAs are designed in such a way that they include numerous tasks, e.g. practical work, investigations, field work, projects, problem solving, presentations, interviews, report writing, peer assessment and self assessment. CTAs and school based Continuous Assessment (CASS) scores are sent to the National Department of Education to be captured for the Grade 9 certification purposes as an exit level.

1.3 The Purpose of CTAs

Common Tasks for Assessment (CTAs) are used as an external summative assessment instrument. They provide the information on the validity, the reliability and the fairness of the school-based assessment. In the Revised National Curriculum Statement for grades R – 9, the Department of Education states that the purpose of CTAs is to:

i. ensure consistency in teacher judgments,
ii. promote common standard setting,
iii. strengthen the capacity for school-based continuous assessment,
iv. increase accuracy of the assessment process and tools,

v. ensure that the school-based assessment tasks properly assess competencies and achievements, and
vi. ensure expanded opportunities for learners.
(Department of Education, 2002 a, p. 79)

To ensure expanded opportunities in assessment means that teachers should find several ways of exposing learners to opportunities that will help them achieve their full potential in terms of knowledge, skills, values and attitudes. According to Poliah (2003) the purpose of CTAs as implemented in the South African education system is as follows:

i. It is used as an external summative assessment instrument.
ii. It provides information on the validity, the reliability, and the fairness of continuous assessment (CASS).
iii. It contributes to credibility and public confidence in the GETC.

Poliah (2003) further said that other benefits of implementing CTAs are as follows:

i. The CTAs provide benchmarking and standardization across provinces, regions, districts and schools.
ii. The CTAs can be used by teachers in their School-Based Assessment (SBA) in subsequent years.
iii. The CTAs contribute to the strengthening of Continuous Assessment (CASS).
iv. The CTAs will show teachers how to set tasks and activities according to Outcome-Based Assessment (OBA) principles, using rubrics to assess outcomes, and linking marks to descriptors.

From this we can deduce that CTAs will influence teachers' practices, and therefore it should be investigated which practices are influenced by CTAs.

I could also deduce that CTAs are set to assist the teachers to comply with the Outcome-Based Assessment (OBA) principles. The OBA principles state that assessment should:

i. assist learners to reach their full potential,
ii. be participative, democratic and transparent,
iii. involve learners actively using relevant knowledge in real – life contexts,
iv. be integrated throughout the teaching and learning process, and
v. be used for remedial as well as enrichment purposes
(Department of Education, 2002 b, p. 4).

The fourth principle states that the assessment should be integrated throughout the teaching and learning process. From this principle it is clear that assessment should be part and parcel of teaching and learning. CTAs, as a form of assessment, should also be incorporated into teaching and learning activities of the schools.

The criteria used to evaluate CTAs are as follows:

i. The tasks should integrate knowledge, skills, values and attitudes.
ii. The tasks should be grounded in real world contexts.
iii. The tasks should assess a variety of outcomes.
iv. The tasks should be structured such that learners could be helped to succeed.
v. The tasks presented to learners should be feasible or attainable.
vi. The tasks should allow for multiple solutions.
vii. The tasks should be clear, (Department of Education, 2002 b, p. 13).

These criteria are consistent with OBE assessment principles. These principles suggest that assessment should be authentic, participative, democratic, transparent and supportive (Van Rensburg and Twala, 1998). From these principles it can be deduced that assessment should be incorporated into daily classroom activities. Assessment should be integrated throughout the teaching and learning process. From what transpires above, it can be deduced that assessment influences teaching and learning in the classroom. The

task that lay ahead of my research was to determine whether CTAs, as a form of assessment, do influence the teaching and learning process and to what extent do they influence teaching and learning.

The Critical Outcomes (COs) of South African OBE state that the learners will be able to:

i. identify and solve problems and make decisions using ***critical and creative thinking***;
ii. work effectively with others as members of a team, group, organization and community;
iii. organize and manage themselves and their activities responsibly and effectively;
iv. collect, analyze, organize and critically evaluate information;
v. communicate effectively using visual, symbolic and language skills in various modes;
vi. use science and technology effectively and critically showing responsibility towards the environment and health of others; and
vii. demonstrate an understanding of the world as a set of related systems by recognizing that ***problem solving*** contexts do not exist in isolation.
(Department of Education, 2002 a, p. 1).

If we take a closer look at these Critical Outcomes, we can see that South African education is now aimed at accentuating ***critical thinking*** and ***problem solving***. Hobden (2005) noted that critical thinking and problem solving are not yet properly used in South African schools.

Poliah (2003) said CTAs assess the following:

i. cognitive competencies (i.e. problem solving, critical thinking, formulation of questions, searching for relevant information, investigation, inventing and creating new things, analyzing data, presenting data communicatively, oral and written expressions);

ii. meta-cognitive competences (i.e. self-reflection and self evaluation);
iii. social competences (i.e. participation in discussions, leading discussions, working in groups, persuading and cooperating);
iv. affective dispositions (i.e. perseverance, internal motivation, initiative, responsibility, self-efficacy, independence, flexibility, coping with frustration).

I have noticed that the competences targeted by CTAs include theoretical and mathematical problem solving, inquiry skills, investigations, practical work, projects, field-work, presentations, report writing, group work, self-assessment and peer-assessment. These competences are associated with problem solving. To me it seems as if critical thinking and problem solving are the core competencies targeted by CTAs. I therefore believe that CTAs were introduced to accentuate critical thinking and problem solving in South African schools which is the core aim of Outcomes-Based Education.

Apart from critical outcomes South African OBE also has Developmental Outcomes (DOs). The Developmental Outcomes state that learners will be able to:

i. reflect and explore a variety of strategies to learn more effectively;
ii. participate as responsible citizens in the life of local, national and global community;
iii. be culturally and aesthetically sensitive across range of social contexts;
iv. explore education and career opportunities; and
v. develop entrepreneurial opportunities (Department of Education, 2002a, p. 1).

The developmental outcomes encourage learners to develop the knowledge and understanding of the diversity of South African community. This includes culture, religion and ethnic components of the community. They also encourage learners to inculcate the values of good citizenship, i.e. responsibility and accountability. Learners should keep in mind the challenges and obstacles that they come across in life, e.g., poverty, inequality, unemployment, HIV/AIDS, etc. This means that their innovative and

creative skills, as well as their critical thinking and problem solving abilities should be enhanced. CTAs aim at improving these abilities.

South African OBE also has outcomes that are directly associated with specific learning areas. These are known as Learning Outcomes (LOs). Learning Outcomes are statements of what the learners should know, demonstrate and be able to do in a particular Learning Area (Department of Education, 2003). LOs speak of competences that the learners should achieve in the Learning Area. In Natural Science there are three Learning Outcomes, viz LO_1, LO_2 and LO_3. LO_1 deals with scientific investigations. It relates to learners' ability to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts (Department of Education, 2003). LO_2 deals with construction of scientific knowledge. It says that learners will be able to interpret and apply scientific, technological and environmental knowledge. LO_3 deals with the interaction of science, society and environment. It says learners will be able to demonstrate the interrelationship between science, technology and society (Department of Education 2003). It looks into the effect of science and technology on the society and environment.

CTAs link very well with Natural Science LOs, because CTAs require learners to carry out investigation, construct knowledge and also become conscious of impact of science and technology on the environment and society. CTAs are problem oriented tasks. For an example, 2008 CTA looked into the electricity supply problem in South Africa. CTAs also assess learners' ability to collect information from various sources, and their ability to analyze and organize information (Poliah, 2003). CTAs also link science with society and environment. For an example, 2009 CTAs looked into the effects of mining to the society and environment. It looked on to the diseases that affect people working in the mines and those that live close to the mines, e.g., asbestosis, mesothelioma, pneumoconiosis, silicosis etc. It also looked into water pollution in the rivers that run closer to the mines and the effect of that pollution on the animals living in those rivers. This shows how science and technology can affect society and environment negatively if

ethical values are not taken into consideration, hence the need for implementing CTAs in the Natural Science Learning Area (NSLA).

In the next section I will represent the key issues that drive OBE in the SA context and relate these to the NCS with the view to establishing how these issues have shaped the course of CTAs.

1.4 Outcomes-Based Education

Outcomes-Based Education (OBE) is "a learner centred, result-oriented approach to learning" (Van Der Horst and McDonald, 1997, p. 5). OBE is based on constructivism. Constructivism is the theory that states that learning "is the active process of constructing or putting together conceptual frameworks or reality" (Cobern, 1995, p. 11). Constructivist model, according to Cobern (1995), suggests that in teaching-learning situations:

1. Students are always active when learning takes place.
2. Learning does not occur by transmission but by interpretation.
3. Interpretation is always influenced by prior knowledge.
4. Interpretation is facilitated by instructional methods that allow for the negotiation of ideas (p. 12)

Constructivism therefore implies that learners should be allowed to engage in negotiations and interpretations. Teaching strategies that promote co-operative learning are idealistic for constructivism to succeed. These are also the principles that underpin OBE philosophy.

Van Der Horst and McDonald (1997) stated that OBE is based on the following beliefs:

1. All learners are capable of realizing their educational goals if they are allowed to learn to their full potential. This means that both teachers and learners must work

hard and have high expectations for success, regardless of background, age, sex or contexts.

2. All different stakeholders in education such as the government, community, teachers, learners and parents share the responsibility for learning. OBE suggests that different stakeholders should work co-operatively in developing and implementing the curriculum.
3. Learning environments that are inviting, motivating and challenging should be maintained for proper learning to take place. The learning atmosphere should be positive and should promote the culture of learning.
4. A positive and constructive ongoing assessment should be upheld so as to build a positive self-esteem and intrinsic motivation on learners.

Such beliefs make OBE to be perfect for the South African context. After 1994 South Africa made a shift from apartheid to democracy. During the apartheid era the South African education system was organized along racial lines. As a result of the division that existed during the apartheid era, learners were not taught properly and appropriately (Van Der Horst and McDonald, 1997). The old education system was not serving the needs of all learners in the country. The elements critical to successful modern education, i.e. equity, access to all, quality assurance and redress were missing in the old education system (Van Wyk, Mothata and Steenkamp, 1998). The old education system was content based, compartmentalized into subjects, exam driven and with inflexible time-frames. The learners in the old education system were passive and were taught in the parrot fashion (Department of Education, 1998). The critical elements central to successful modern education system like equity, access to all, lifelong learning, quality assurance, critical thinking, problem solving, learner-centred, etc. were missing in the old education system (Van Der Horst and McDonald, 1997; Van Wyk, Mothata and Steenkamp, 1998). The change in the education system in South Africa was therefore necessary and OBE was the answer. OBE provided a more balanced view in education and was set to redress the imbalances and the injustices of the past.

Killen (2007) stated that there are four essential principles of OBE, namely: (1) Clarity of focus, (2) Design back, (3) High expectations and (4) Expanded learning opportunities. Clarity of focus suggests that the education system should be organized in such a way that both teachers and learners can focus clearly, consistently, systematically and creatively on significant outcomes. Design back means that all instructional decisions are made by tracking back from desired or significant outcomes. High expectation means that the teachers should have a positive attitude towards each and every learner. Teachers should expect all learners to achieve significant outcomes to a high standard. This is very appropriate to South African contexts as Black learners were looked at as low achievers in the old education system. Expanded learning opportunities refer to the use of flexible time in learning. Learners don't learn at the same pace, so learning time should be arranged in such a way that all learners will have appropriate opportunities to achieve significant outcomes. Such arrangement is appropriate to South African education system since different communities received different education in the past. The imbalances of the past are still evident even today in South African education. It was discovered that the socio-economic background affect learners ability to learn (Howie, 2003), therefore the use of expanded learning opportunities postulated by OBE is necessary to help to address this problem. In my opinion OBE seems suitable to South African education so as to redress the imbalances of the past. The curriculum brought forth with OBE is referred to as Curriculum 2005. Curriculum 2005 was later revised and it emerged as the Revised National Curriculum Statement (RNCS). The Revised National Curriculum Statement was aimed at promoting commitment as well as competence among teachers (Department of Education, 2002a). The Revised National Curriculum Statement (RNCS) was later changed to National Curriculum Statement (NCS). In order to support this process the Department of Education provides policy guidelines that underpin the National Curriculum Statement for each Learning Area.

1.5 The National Curriculum Statement

The National Curriculum Statement (NCS) in the South African context is a statement that indicates the role of teachers and specialists in the development and implementation

of effective teaching, learning and assessment. It also integrates the learning programmes and work schedules. The NCS is an embodiment of the nation's social values and its expectations of roles, rights and responsibilities of the democratic South African citizen. The NCS is underpinned by the following principles:

1. Social Justice
2. Healthy Environment
3. Human Rights
4. Inclusivity (Department of Education, 2003, p. 5).

Social justice refers to individual's responsibility to care for other people to the common good of the society. Social justice serves to remind the citizens of the limits within which their rights can be exercised. It emphasizes that everybody should have equal opportunity to improve his/her living conditions. A healthy environment refers to social, political, economical and biophysical dimensions of life that are conducive to healthy living. It also includes the life support systems like air, water and soil that should be treated in such a way that life on earth is not destroyed. Human rights refer to basic rights to which every person is entitled. These include right to life, education, justice, freedom, healthy living etc. The NCS negates the infringement of these rights. Inclusivity refers to the engagement of practices that ensure the full participation of all learners in school activities irrespective of their culture, race, language, economic background or ability. The NCS upholds that all learners come with their own experiences, interests, strengths and weaknesses and all need to be accommodated. As we emerged from apartheid to democracy such principles are appropriate to our society. The NCS is therefore relevant to South African contexts. It will help to unite the societies that were separated by apartheid in the past. Relevant to science, NCS is written in such a way that it promotes the scientific literacy amongst all the learners in the education system and provides access to science education for all. In this way it addresses the imbalances of the past.

The National Curriculum Statement is aimed at promoting commitment and competence among teachers and learners. To do so the NCS outlines Learning Area Statements for

each Learning Area. The Learning Area Statements stipulate the purpose, concepts, skills and values of the Learning Areas. The NCS states that the purpose of Natural Science Learning Area is to promote scientific literacy. The statement claims that this can be achieved by developing and enhancing the use of science process skills; developing and application of scientific knowledge and understanding; and by promoting the appreciation of relationships and responsibilities between science, technology, society and environment (Department of Education, 2002a), hence three Learning Outcomes. The process skills developed by Natural Science Learning Area (NSLA) include the skills to investigate, reflect, analyze, synthesize and communicate information (LO_1). The scientific knowledge and understanding envisaged by Natural Science Learning Area is a cultural heritage that can be used to answer questions about the nature of the physical world; lay the basis for further studies in science and technology; prepare learners for economic world; and prepare learners for active participation in a democratic society (LO_2). In connecting science, technology and society, Natural Science Learning Area takes into cognisance that science has both positive and negative impact on our world. Having this in mind the Leaning Area Statement states that teaching and learning in Natural Science should promote the understanding of science as human activity; the history of science; the relationship between Natural Science and other Learning Areas; the contribution of science to social justice and societal development; the responsibilities of science to society and environment; and the consequences of decisions that involve ethical issues (LO_3), (Department of Education, 2002a).

CTAs were introduced to assist and facilitate the attainment of these outcomes. For example, in 2008 and 2009 CTAs, learners were asked to carry out investigations of cellular respiration and energy transfer from burning substance to water. They were also required to make anemometer from paper cups. These tasks assessed learners' process skills (LO_1). The CTAs also looked into molecular structures of methane (CH_4), oxygen gas (O_2), carbon dioxide (CO_2) and water (H_2O). They looked also to the reactions involving these compounds. These CTAs looked again into CO_2 and carbon cycle in the atmosphere. This concerned the development of scientific knowledge and understanding (LO_2). The CTAs also looked into the air-pollution caused by burning fossil fuels,

especially the CO_2 produced by burning coal in coal power stations and the alternative energy sources that will be less pollutant than coal, e.g. wind powered electric generators. They also looked into the problems that will arise in future as the result of steady decrease of fossil fuels and natural resources; and mining related diseases. These concern the interaction between science, society and environment (LO_3). This shows how CTAs can be used to facilitate the attainment of all Learning Outcomes in the Learning Area. From this we can see that Natural Science Learning Area (NSLA) seeks to locate science issues within the broader context of political, social and economical situations; and CTAs seek to assist the Department of Education to achieve this goal.

The National Curriculum Statement (Department of Education, 2003) groups Natural Science study into four main content areas, namely:

1. Life and Living,
2. Energy and Change,
3. Planet Earth and Beyond
4. Matter and Materials. (p. 24)

Life and Living focuses on life processes and healthy living. It also looks on understanding balance and change in environment, and the importance of biodiversity. Energy and Change focuses on how energy is transferred in physical and biological systems (Department of Education, 2002a). It also looks into the consequences that human needs and wants have on energy resources. Planet Earth and Beyond focuses on the structure of the planet earth and how the earth changes over time. Matter and Materials focuses on the properties and the uses of matter and materials. It looks into the understanding of structure, changes and reactions of matter and materials in order to promote desirable changes. Structuring scientific knowledge and activities like this is appropriate because it is not possible to put them all under a single heading.

1.6 External Assessment At Grade Nine

Grade 9 is an exit level of the GET band. It is envisaged that learners from Grade Nine classes will join the FET band either in Secondary Schools or in FET colleges. Also it was believed that these learners will be able to exit school education and join the work force or further their education in the work place. Grade 9 exams therefore should validate that the level of education that the learners have at this point is suitable for such exit. All the assessment tasks at school should assess that the learners have achieved outcomes needed for exiting school or the GET band. An external leverage to change teachers' behaviours such that they ensure that learners have achieved all the outcomes was necessary. CTAs were therefore introduced to act as an external form of leverage to enforce the attainment of this objective.

The external assessment (CTAs) at Grade 9 level is in accordance to the policy framework for the assessment and promotion of learners in Grade 9. This policy states that:

1. The external assessment (in Grade 9) is conducted through Common Tasks for Assessment. These are designed to sample learner achievement in each learning area through tasks that encompass a range of appropriate and relevant assessment techniques and activities. The Common Tasks for Assessment will be designed, developed and set by the Department of Education in collaboration with the Provincial Departments of Education.

2. The Common Tasks for Assessment are developed for each Learning Area and should consist of various assessment activities. They are designed in such a way that they should be administered over a period of time and not as a once off event. Learners in Grade 9 must participate in these.

3. The Common Tasks for Assessment must be administered at least once a year, during the fourth quarter. The administration of Section A must be

infused into the routine schedule of the school, Section B constitute a formal examination.

4. The Department of education will fulfill a co-ordinating, supportive and monitoring role.

5. Teachers should mark the Common Tasks for Assessment using the supplied marking guide or memoranda and officials of the Provincial Departments of Education must monitor and moderate the marking.

6. The Provincial Departments of Education should organize all the processes involved in the administration of the Common Tasks for Assessment.

7. The Council for General and Further Education and Training Quality Assurance (UMALUSI) will attest to the standard, appropriateness and applicability of Continuous Assessment and the Common Tasks for Assessment.

8. The Provincial Departments of Education must ensure that appropriate moderation procedures at school and district levels are in place to verify and moderate Continuous Assessment and the marking of the Common Tasks for Assessment.

9. The Common Tasks for Assessment will also serve as a validation tool for school-based assessment. (Republic of South Africa, 2003)

Assessment provides learners with feedback on how they have met the expectation as described in the Learning Outcomes and Assessment Standards (Department of Education, 2003). The feedback leads to the change of attitude towards teaching and learning. It encourages teachers to improve their teaching strategies and also encourages

the learners to improve their learning. The assessment tasks that enhance this process are those that require the learners to apply their knowledge and reasoning to situations that are similar to those that they will encounter in the outside world. Assessment task therefore should be developmental and appropriate to learners' understanding. They should be familiar to learners and should require the skills that are at learners' grade level and must be as free from bias as possible. It is for this reason that assessment tasks are to be guided by Assessment Policy. To ensure that the Assessment Policy is followed correctly, the external assessment, in form of CTAs, is necessary at Grade 9 level. The external examination at Grade 9 level assists in highlighting the core knowledge and conceptual frameworks that should be covered.

1.7 The Purpose and Focus of the Study

The main purpose of this study was to investigate the influence of common tasks for assessment (CTAs) on the pedagogical practices of Grade 9 Natural Science teachers in South Africa. The pedagogical practices in this case could be teaching strategies or the work the teachers give to students. I have noticed that CTAs are problem oriented tasks, so I have a hunch that they influence the strategies that are associated with problem solving. My key research questions therefore are:

1. What are the teachers' views on CTAs as teaching and learning tools in SA schools?
2. What influence do CTAs have on the pedagogical practices of Grade 9 Natural Science teachers?

As I have said above, CTAs are problem oriented tasks, so I will use problem solving as one of my frameworks in this research. Problem solving, in an academic way, can be defined as "a multifaceted cognitive activity in which we engage when we are confronted with the task in which routine action or normal thinking does not allow us to go from the given situation to the desired goal, but rather there is recourse to some form of critical thinking" (Hobden, 2005, p. 2). As a multifaceted activity, problem solving can take

many forms in the classroom. In a science class, for example, problem solving could be in a form of practical work, investigations, projects, report writing, field work as well as theoretical and in mathematical problem solving. These are competences involved in CTAs.

If one is involved in problem solving, one uses ***critical thinking***. Critical thinking can be defined as "an intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing and evaluating information gathered from or generated by observations, experience, reflections, reasoning or communication, as a guide to belief or action" (Hobden, 2005, p. 2). Critical thinking involves cognitive activities like interpretation, analysis, evaluation, inference, explanation and self regulation (Facione, 1998). It also involves logical skills like reasoning, reflecting, inventing, imagining, planning, estimating and predicting. Pithers and Soden (2000) said that in order to promote critical thinking and problem solving, learners should be subjected to situations where they can discuss, argue, debate, ask questions, seek information related to given tasks, reflect on their core ideas and should be taught to tolerate ambiguity and uncertainty. They said learners should be allowed situations where they will have to state assumptions and specifications, generate hypothesis, give explanations, interpret observations and make classifications and deductions. These are principles underpinning common tasks for assessment and I intended to determine the extent to which teachers engage them in their practices.

Problem solving can be engaged in many ways in a classroom. Learners can be given work that will require them to apply theory they have learned in the class. This means that they could be given work that will require the application of physics, chemistry or biology principles or laws, and or mathematical skills. They could be given problems that will require them to use their practical or investigation skills. Such work will involve experiments done in the laboratory, classroom or even at home. Learners could be given projects and be asked to reflect on their experiences as they carry out these tasks. Learners could be allowed to have group discussions and present their findings to the class and also be ready to defend their findings if their peers or other people ask them

questions about their findings. They should also be taught the culture of tolerance and consideration. They should be willing to accept other people's ideas if proven to be better or more correct than theirs. Learners should be given a chance to do self – assessment and also do peer – assessment in the class. CTAs involve such activities and I decided to investigate their employment in the classroom. I seek to determine whether teachers' practices have moved towards these expectations and to determine which of these are specifically influenced by CTAs the most.

In my study I looked into few teachers' practices that could be influenced by CTAs. These include problem solving (theoretical or mathematical), practical work (normal/exercises or investigations), projects, field work, report writing, learners' presentations, self-assessment and peer-assessment. I acknowledge that these are constructs, i.e. characteristics that cannot be directly observed or measured but can be inferred from patterns in people's behaviour (Leedy and Ormrod, 2005), so they need to be operationalised. I used questionnaire with Likert scale and nominal scale to operationalise them. I have also realized that the influence of CTAs on teachers' practices could also be affected by other factors like teachers' qualifications, teaching experience, inservice training, school profile, support mechanism and learners' characteristics. These were the intervening factors in my study (Neuman, 2006). I also took these factors into consideration when I analyzed the results.

1.8 Research Overview

My research followed the interpretive mixed mode approach. I administered questionnaires to 80 schools in the Ethekwini region. I followed up with interviews of five teachers also teaching at Ethekwini region. Questionnaires were used to get the broader picture of the phenomenon, the influence of CTAs on the pedagogical practices of Grade 9 Natural Science teachers, and interviews were used to probe the phenomenon even further and to investigate the teachers' views on CTAs. Interviews were used to validate the information that transpired from questionnaires. I believed that such triangulation would make the findings of the study more credible.

CTAs fall under education measurement or assessment. I have therefore reviewed literature on assessment and how assessment influences teaching and learning in the class. Ebel (1998) pointed out that assessment improves teaching, motivates learners and directs class activities. Khattri, Kane and Reeve (1995) also indicated that assessment informs teaching and learning. What remained to be seen was whether CTAs, as form of assessment would influence Grade 9 Natural Science teachers' practices. I have also reviewed literature on instructional strategies to find out which strategies could possibly be accentuated or influenced by CTAs. I have also reviewed literature on critical thinking and problem solving. I have realized that CTAs are problem oriented tasks, so the teaching strategies associated with critical thinking and problem solving could be influenced by CTAs. The literature review is presented in Chapter 2 of this dissertation.

The research method that was followed in this study, as explained above, was the interpretive mixed mode approach. Questionnaires and semi-structured interviews were used. The explanation on how questionnaires were administered and how interviews were conducted are given in Chapter 3, the research methodology chapter. Also in that chapter it is explained how sampling was done and how data was collected.

Chapter 4 of this dissertation contains the information on how data was analyzed and what were the findings of the study from the data analysis. The findings contain the views of teachers on the CTAs and the influence of CTAs on the pedagogical practice of the teachers. Chapter 5 serves as a conclusion on the study and explains whether CTAs influence the pedagogical practices of Grade 9 science teachers and how do they influence them.

1.9 The Scope and Limitations of the Study

My study covered a small spectrum of science education, i.e. the influence of CTAs on Grade 9 Natural Science teachers in South Africa. It was limited to schools that are in the Ethekwini region of KwaZulu-Natal in South Africa. Questionnaires were sent to 80

schools and 5 teachers were interviewed. I believed that if 80 questionnaires are sent to schools, at least 50 would come back for analysis. I believed the analysis of 50 questionnaires would be sufficient to give the overall picture of how CTAs influence Grade 9 Natural Science teachers' practices. The interviews of 5 Grade 9 Natural Science teachers served to verify the validity of the questionnaires' findings. Although I would have loved to work with more data sources, the time and financial constraint limited me to this level of data collection. Though small as it may be, I believe that the results coming from this data can be valid and reliable. The data was collected from rural, urban and township schools. This sample represented most catchment areas of schools in the Ethekwini region.

1.10 Conclusion

Having presented the rationale for my study in relation to CTAs and establishing my key research questions, I will present the views of other researches on assessment in the next chapter. An emerging theoretical framework will be described and will serve to support my data analysis in chapter four.

CHAPTER 2

LITERATURE REVIEW

Since CTA's fall under education measurements or assessment, my literature review therefore concentrated on assessment. I reviewed literature on the importance of assessment, the principles of assessment, the features of assessment tasks and also the literature on how does assessment influence teachers' practices. Since teachers' practices also involve instruction strategies, I also reviewed literature on instructional strategies. I committed myself to such approaches so that I could determine which instructional strategies are influenced by CTAs. I also reviewed the literature on constructivism and problem solving because I intended to use these as a theoretical framework to inform my study and contribute to the analysis of my data as indicated in the previous chapter.

2.1 The Importance of Assessment On Teaching And Learning

Assessment can be described as "a process of gathering valid and reliable information about the performance of a learner against clearly defined criteria using a variety of methods, tools and techniques in different contexts" (Department of Education, 2002b, p. 6). There are many reasons for assessing students learning, and among others, assessment is used to:

(i) allocate learners to set groups,
(ii) inform parents about learners' progress,
(iii) give incentives for learning,
(iv) assess the effectiveness of instruction,
(v) identity individual problems and weaknesses,
(vi) reveal errors and misconceptions,
(vii) give feedback to learners on their progress,
(viii) give more practice of a concept or idea,

(ix) aid revision prior to formal assessment,

(x) inform employers or higher education institutions about outcomes attainment (Knutton, 1996, p. 2).

One of the reasons given above for assessing learners is that assessment also measures the effectiveness of instruction. If it is so then one can deduce that assessment will inform teachers' practices. This might mean that teachers change or adapt their instructional strategies to comply with the requirements of assessment.

Van Rensburg and Twala (1998) stated that assessment should be continuous, formative, summative, diagnostic, criterion referenced, performance driven and authentic. Continuous assessment (CASS) is a form of assessment that takes place on a continuous basis, not just at a single point towards the end of the year or term. This means that assessment should be a process, and not just be an event at the end of the year as in old education system. If assessment is carried on continuous basis, it becomes part and parcel of teaching practice. Such assessment is beneficial to both the teacher and the learner. That being the case, the assessment should influence or inform teachers' practices.

According to Broadfoot (1979) and Knutton (1996) diagnostic assessment is an assessment designed to identify the learning difficulties of the individual leaner so that appropriate action can be taken to help the learner concerned. This will help the learners to know where they have gone wrong and also help to show them how they may rectify the situation. The overall score of the learner will be of secondary importance on diagnostic assessment and the most important thing will be to identify and solve the learning difficulties. Diagnostic assessment is closely related to formative assessment. While diagnostic assessment is used to identify learning difficulties, formative assessment is used to plan and support the next stage in the teaching and learning process.

At the end of the year all the assessment activities of the learner are aggregated. This is known as summative assessment. A summative assessment process recognizes the overall

achievement of a learner. It integrates all the work done by the learner from the beginning of the year and is used to communicate the learner's achievement to all interest parties. It can also be used to evaluate the educational process. Summative assessment is used when promoting a leaner to the next class or when a learner is transferred from one school to another. Assessment in South African schools is informed by Assessment Standards.

2.2 The Principles of Assessment

In the Department of Education discussion document on assessment (Department of Education, 1997, p. 43) the following principles were put forward as principles underpinning assessment:

(i) be relevant to the curriculum,
(ii) be an integral part of teaching and learning,
(iii) be balanced, comprehensive and varied,
(iv) be valid ad reliable,
(v) be fair and authentic,
(vi) engage learners,
(vii) value teachers' judgment,
(viii) be time efficient and manageable,
(ix) recognize individual achievement and progress,
(x) convey meaningful and useful information.

The principle number two above states that assessment should be an integral part of teaching and learning. If assessment is an integral part of teaching and learning it will influence teaching and learning. From this principle we can deduce that, apart from measuring education achievement, assessment can improve pedagogical practices of teachers. If it is so then it means that CTAs will influence teachers' practices.

Van Rensburg and Twala (1998) suggested that the following assessment methods should be used when assessing learners:

(i) Portfolio assessment

(ii) Performance assessment

(iii) Project assessment

(iv) Product assessment

(v) Pen and paper assessment

(vi) Observation assessment

(vii) Journal assessment

(viii) Systematic assessment.

Systematic assessment is an external assessment designed by the department of education to monitor the education system by comparing learners' performance to national indicators of learners' achievements (Department of Education, 2002b). Systematic assessment is supposed to be conducted at the phase exit level i.e, Grade 3, Grade 6 and Grade 9 in GET band and Grade 12 in FET band. Systematic assessment is used in curriculum development and in evaluation of teaching and learning. CTA's fall under systematic assessment.

2.3 Features of Assessment Tasks

One of the principles of assessment (Department of Education, 1997) is that it should be fair and authentic. Authenticity in assessment means that it should use knowledge in real life contexts (Van Rensburg and Twala, 1998). This implies that the tasks in the assessment should be meaningful and multi-dimensional, i.e, they should include knowledge, skills, abilities, critical thinking, metacognition, values and ethics. This means that assessment should be an integral part of teaching and learning and should be cross-disciplinary (Department of Education, 2003). Such practice would be following a cognitive approach to teaching and learning, and will benefit the learners. The cross disciplinary approach would also enhance conceptualization in science.

For assessment task to add value to education, they should be very good and educationally balanced. Eisner (1993) gave the following guidelines to be followed when preparing assessment tasks so that they can be regarded as good assessment tasks:

(i) Assessment tasks should be related to real life problems. This means that they should be related to the world outside school and not limited to school life only. For example, we rarely find problems in real life that can be solved with influence of multiple choice questions. The use of multiple choice questions in school assessment is therefore questionable. If learners are used to multiple choice questions only, they will not be able to solve problems in real life situations. Real life problems are complex and need good problem solving skills which are not attained by handling multiple choice questions only.

(ii) Assessment tasks should be set in such a way that they can reveal how the students go about solving them. They should allow for full and detailed solution. This means that assessment tasks should involved critical thinking. This will improve the quality of reasoning or process thinking in learners.

(iii) Assessment tasks should reveal the intellectual values of the domain from which they are derived. This means that task should allow the student to display their understanding of vital ideas, concepts, principles, frameworks and relations in the subject domain. When educators set assessment tasks they have to bear in mind that problems are domain specific, therefore they should make sure that the students are capacitated to deal with particular tasks in that specific subject domain. They should have the resources (i.e. body of knowledge underpinning the problem) and the heuristics (i.e. the problem solving strategies or techniques) of the subject domain from which the problem is derived.

(iv) Assessment tasks should not be limited to individual performance but should require participation and co-operating of team or group members. This is done so that assessment tasks could be related to real life situations. In real life we seldom

solve problems as individuals but rather as team members, colleagues, friends or relatives.

(v) Where possible assessment tasks should be open-ended, i.e., they should have more than one acceptable solutions or acceptable answers. This is desirable so as to allow students to use various problem solving strategies. Also this could facilitate discussion and debates in the classroom, a situation which is desirable for OBE. Again, problems in real life situations are seldom close-ended, they usually have more than one alternative solutions.

(vi) Assessment tasks should require students to display configuration sensitivity, and not just discrete elements. This means that assessment tasks should lend themselves as larger problematic situations which will require critical thinking and wider problem solving skills.

(vii) Assessment tasks should permit students to select their form of representation (media) to display what they have learned. There are many forms of representation that students can use e.g. posters, role play, graphics, charts, essays, audio-visuals, projects, etc. Such a practice will symbolizes to students that their personal preferences or individual interpretation and creativity are valued at school.

I have realized that CTAs conform to these features. To me these features mean that assessment should be carried out on a continuous basis. Such tasks should be given more time than the usual time allocated for exam papers. If such practice is carried out at school, assessment would become an integral part of teaching and learning. If assessment is a part of a teaching-learning situation it would influence activities in the classroom (Bell and Cowie, 2001).

The features listed above are in accordance with characteristics of holistic assessments. Holistic assessment integrates knowledge, understanding, skills, attitude, values and

ethics (Hager, Gonczi and Athanasou, 1998). They also said that for the assessment to be holistic, the tasks should:

(i) be problem orientated,
(ii) be inter-disciplinary,
(iii) embrace professional practice,
(iv) cover group of competences,
(v) focus on common circumstances,
(vi) demand analytic abilities, and
(vii) combine theory and practice (Hager, Gonczi and Athanasou, 1998, p. 57).

These features are found in CTAs. CTAs integrate competences in a holistic way. They combine knowledge, skills, understanding, values and ethics. They are carried out over a long period of time as compared to usual exams. Usually each CTA paper takes about 10 hours over a period of two weeks. Students work as a group and also as individuals. They are given a chance to present, support or defend their findings and solutions. This exercise makes teachers and learners to be actively involved in the assessment process. If one looks at the way CTAs are set and how this whole assessment process is carried out, it becomes clear that they are set to shift the assessment paradigm. To me it seems as if CTAs are set to show us how to deal with problem solving and critical thinking. They are problem oriented and they require a lot of critical thinking. If that is the case, CTAs will influence or inform teachers' practices. What remains to be seen then is to what extent do CTAs achieve these objectives? This is the purpose of my study.

2.4 Assessment In Natural Science

Assessment in Natural Science can be formative, summative, or diagnostic (Manitoba Education and Youth, 2003).

Formative assessment is given during the instructional unit and provides learners and teachers with information about learners' progress in accomplishing identified learning instructional programming content, methods, sequence, and pace.

Summative Assessment is based on an interpretation of the assessment information collected and is given at the end of an instructional unit. It helps determine the extent of each learners' achievement of learning outcomes. Evaluation should be based on a variety of assessment information. Summative assessment is used primarily to measure student achievement, to report to parent(s) or guardian(s), learners, and other stakeholders, or to measure the effectiveness of instructional programming.

Diagnostic assessment is given before instruction and determines learners' understanding of topics before learning takes place.

There are several strategies that can be used to assess learners in Natural Science. A range of assessment strategies, such as observation, interviews, group/peer assessment and performance based assessment (Manitoba Education and Youth, 2003). These can be used in the Natural Science classroom. The same strategy can be used for both formative and summative assessment, depending on the purpose of the assessment. These assessment strategies are discussed below:

1. **Observation:** Observation of learners is an integral part of the assessment process. It is most effective when focused on skills, concepts, and attitudes. Making brief notes on index cards, self-adhesive notes, or grids, as well as keeping checklists, help teachers maintain records of continuous progress and achievement.
2. **Interviews:** Interviews allow teachers to assess an individual's understanding and achievement of the learners learning outcome. Interviews provide learners with opportunities to model and explain their understandings. Interviews may be both formal and informal. Posing science related questions during planned interviews enables teachers to focus on individual learner skills and attitudes. Learners reveal

their thinking processes and use skills when they are questioned about how they solved problems or answered science questions. Using a prepared set of questions ensures that all interviews follow a similar structure. It is important to keep a record of learner responses and/or understandings.

3. **Group/peer assessment:** Group assessment gives students opportunities to assess how well they work within a group. Peer assessment gives them opportunities to reflect on each other's work, according to clearly establish criteria. During the peer-assessment process, learners must reflect on their own understanding in order to evaluate the performance of another student.
4. **Performance Bases Assessment:** It is an assessment that equips learners with investigation skills. The following–based approaches and strategies can be used to assess learners' knowledge and skills in performance assessment:

(i) Interpreting media reports of science: Short pieces extracted from newspaper could be used to assess whether learners understand the scientific content of the piece; whether they can identify and evaluate the possible risks and quality of the evidence presented; whether they can offer well-thought-out reactions to the claims and finally whether they can give their own opinions about future action that could be taken by individuals, government, or other bodies.

(ii) Asking and answering questions based on data: Such questions should assess learner's ability to represent data in a variety of ways to formulate and interpret the messages that can be extracted from data and to detect errors and dishonesty in the way data are presented or selected. The ability to manipulate and interpret data is core skill that is of value, not only in science, but also in a wide range of other professions and contexts.

(iii) Recognizing the role of evidence: At the heart of scientific rationality is a commitment to evidence. Contemporary science confronts the modern citizen with claims that are contested and uncertain. Questions based on historical or contemporary examples can be used to investigate learners understanding of the

role of evidence in resolving competing arguments between differing theoretical accounts. (Miller and Osborne, 1998)

2.5 The Influence of Assessment on Teachers' Practices

There is evidence that assessment does influence teaching and learning (Ebel, 1998; Bell and Cowie, 2001; Klassen, 2006). Stern and Ahlgren (2002) said: "If used properly, good assessment can be a powerful catalyst for improving both curriculum and instruction" (p. 889). If assessment improves instruction it means that it affects teachers' practices. Depending on the type of assessment used, it can have a positive or negative influence. When high stake external exams are used, e.g. Grade Twelve exams, teachers' practices tend to be influenced in a negative way (Madaus 1998). In such a situation teachers narrow their instructional strategies to those things which are only measured by the exam. High stake external exams lead teachers and students to the belief that only a few students can do well in the exam. The majority of the students will do moderately and few will do poorly (Rowntree, 1987). This belief makes teachers to become content with their instructional strategies if they yield the test scores that follow normal distribution, i.e, bell-shape distribution.

In most cases, however, assessment has a positive influence on teachers' practices. Ebel (1998) argues that assessment evaluates and improves teaching, and also motivates and directs students learning. He further argues that assessment improves the quality of education, shows the bearing (direction) to which teaching and learning is heading, and it refines, records and summarizes the observations the teacher makes on the class.From this we can see that assessment influences teachers' practices.

Steadman (1998) stated that the purpose of classroom assessment is to improve teaching and learning, monitor students' learning, improve communication and collaboration within students and to obtain feedback on effectiveness of instructional strategies. It also indicates the students' satisfaction with teaching and classroom activities. She further argues that classroom assessment improves teaching by intrinsically motivating teachers

and learners, and by promoting reflective practice in teachers. Soetaert (1998) stated that 100 % of teachers using the Classroom Assessment Techniques (CAT) program (an external assessment program used in colleges in USA), agreed that the program improves quality of teaching and learning in their classes. When students were asked to comment whether CAT has improved the quality of education in their classes, 76% stated in the affirmative. From this study we can see that assessment, even if it is an external one, can improve teaching and learning when used properly.

It has been observed that assessment helps teachers to improve their teaching skills after joining the teaching profession (Richlin, 1998; Huba & Freed, 2000). Initially novice teachers tend to be dualistic, i.e., they either deny that they are real teachers and they work very hard to be perfect. As they get used to being teachers they tend to focus more on content and suffer from performance anxiety. As they get mature on teaching they tend to look outwards towards their students. Finally they see themselves as partners with their students and the barriers between teachers and students are broken. It has been observed also that CATs assist the teachers to reach the maturity stage earlier than if they don't use CATs (Soetaert, 1998). These findings re-iterate that assessment helps teachers to improve their teaching practices and learners to improve their learning.

2.6 Instructional Strategies

An instructional strategy can be described as "the way in which teachers use media, materials, settings and behavior to create the learning environment to foster desirable outcomes" (Hofstein and Walberg, 1995, p. 70). Instructional strategies are an integral part of teachers' practices. As this study looked into the CTAs influence on the pedagogical practices of Grade 9 Natural Science teachers, it was necessary to re-visit the instructional strategies.

Instructional strategies can be classified into teacher-centered strategies and learner-centered strategies (Hofstein and Walberg, 1995). Teacher centered strategies include the lecture method, demonstrations and the question and answer method. Learner centered

strategies include laboratory learning, inquiry learning, group discussions, projects, field trips, computer assimilations and individual learning. Hofstein and Walberg (1995) stated that the strategies that benefit the students the most are learner-centered strategies and some of them are discussed below:

2.6.1 Laboratory Learning

Laboratory learning can be defined as "a unique educational setting in which students, usually in small groups, interact with materials and equipment to observe phenomena" (Hofstein and Walberg, 1995, p. 72). In this strategy learners confirm the known laws, principles or knowledge but don't do investigations. The aim of this instructional strategy is to promote intellectual development, develop problem solving skills and develop critical and creative thinking skills. Other educators refer to this type of practical work as standard exercises (Boud, Dunn and Hergurty-Hazel, 1986). Apart from these cognitive skills promoted by laboratory learning, it also promotes technical skills like handling and manipulating scientific equipment and understanding the use of these equipment (Boud, Dunn and Hergurty-Hazel, 1986). Laboratory learning is used for normal practical work.

There are many reasons why laboratory learning is used in science education, among others are the following:

1. The laboratory is a place where a person or group of persons engage in a human enterprise of examining and explaining natural phenomena.
2. The laboratory provides an opportunity to learn generalized systemic ways of thinking that should transfer to other problem situations.
3. The laboratory experience should allow each student to appreciate and in part emulate the role of the scientist inquiry.
4. The result of laboratory instruction should be more a comprehensive view of science including not only the orderliness of its interpretations on nature, but also the tentative nature of its theories and models. (Boud, Dunn and Hegarty-Hazel, 1986, p. 15)

Apart from the general purpose given above, laboratory learning also has a specific purpose that is directly connected with day to day activities of the class, and this is:

1. To familiarize students with laboratory equipment,
2. To gain understanding of proper use of various laboratory equipment,
3. To gain the skill of carrying out scientific experiments,
4. To gain the skill of recording experimental results or observations,
5. To train the learners to be able to interpret the experimental results or observations and reach conclusions,
6. To understand and use metric system in simple measurements and calculations,
7. To understand the construction and reading of graphs,
8. To keep neat and accurate records of practical work,
9. To inculcate the sense of responsibility and cleanliness towards the lab and lab equipments, and
10. To understand the purpose of laboratory in the study of science, (Bybee and Trowbridge, 1996, p. 197).

Laboratory learning is associated with hand-on activities. Learners have to manipulate laboratory equipment. This improves their process skills. CTAs assess the development of process skills in learners. They achieve this through the use of practical work, e.g., energy transfer from burning substance to heat water in 2008 CTA. In this way we can see that laboratory learning is consistent with objectives of CTAs.

The criticism that can be leveled against laboratory learning is that in some cases teachers use recipe-type experiments. Teachers tend to use the "tried and tested" experiments and this compromises the purpose of science education in terms of supporting creativity and problem solving.

2.6.2 Inquiry Learning

Inquiry learning is "the instructional strategy that involves the process of conceiving a problem, formulating a hypothesis, designing an experiment, gathering data and drawing conclusions about the problem" (Bybee and Trowbridge, 1996, p. 73). The aim of this strategy is to equip the learners with the skills of conducting scientific inquiry or investigations. The implementation of this strategy needs high-order thinking as it requires laboratory skills of a high level. Hofstein and Walberg (1995) said there is very little success in implementing this strategy in schools even in better equipped schools with well trained teachers. This failure is associated with high level cognitive and psychomotor skills that are associated with this instruction strategy. Inquiry learning is used for real investigations.

Inquiry learning comprises of the following six steps:

1. Identification and clarification of the problem.
2. Formulation of hypothesis.
3. Formulation of data collection method or plan.
4. Data collection.
5. Analysis and interpretation of results.
6. Drawing conclusion from results (Monyai, 2006).

During the identification and clarification period the learners establish exactly what the problem is that needs to be solved. In the hypothesis step the learners predict the outcome or the solution of the problem based on their prior knowledge or experiences that relate to the problem. During the formulation of data collection method the learners come with the plan or strategy that they will use to collect the data or solve the problem. In the data collection step the learners put their plans into action. This could be carrying-out an experiment. In the analysis and interpretation step learners record their observations or tabulate the results. The learners then use their logic or cognitive skills to interpret their observations. They could also use their mathematics skills, e.g. calculations and graphs to

interpret their results. In the drawing conclusion step learners deduce principles, law or theory underpinning the problem or the phenomenon that they were investigating. Learners could come with generalizations or explanation of the phenomenon.

There are many skills developed through inquiry learning and they could be classified into the following categories:

(i) Acquisitive skills
(ii) Organizational skills
(iii) Creative skills
(iv) Manipulative skills
(v) Communication skill. (Bybee and Trowbridge, 1996, p. 192)

Acquisitive skills involve skills like listening (being attentive), observing (being alert and systematic), searching (locating sources), inquiry (questioning things), investigating (problem delineating, hypothesizing, formulating solution strategy), data gathering (tabulating, organizing, classifying and recording) and researching (locating problems, setting up experiments, analyzing data and drawing conclusions).

Organizational skills involve skills like recording (tabulating, charting, graphing), comparing (identifying similarities, differences and features), classifying (putting things into groups or categories), organizing (putting things in order or filling), reviewing (working backward, noticing important things), evaluation (assessing things or strategies) and analyzing (seeing implications)

Creative skills involve skills like planning (formulating course of actions), designing (creating approaches or methods), inventing (creating new methods, strategies, techniques or devices) and synthesizing (putting things together).

Manipulative skills involve skills like instrument usage (assembling and handling equipment, instrument care (cleaning, storage and safe use of equipments), experimenting

(inferring, hypothesizing, collecting data, analyzing data, making conclusions), calibration (taking correct measurements with instruments) and construction (making equipment for experiments).

Communication skills involve skills like questioning (asking and answering questions), discussion (contributing one's ideas and listening to others), explanation (clarifying major points or exhibiting findings), reporting (giving report of the results), writing (experimental reports, worksheets, essays), graphing (charts, maps, graphs) and criticism (constructive evaluation and reflection on one's work).

Inquiry learning promotes investigation skills in learners. CTAs assess the development of investigation skills in learners, e.g., in 2009 CTA learners were required to measure the wind speed with paper cup anemometer which they made on their own. The information they gather from this exercise was going to be used to decide where to install wind turbine in school. The employment of inquiry learning in science classes is therefore desirable so as to meet this aspect of the CTAs.

The skills developed by inquiry learning go a little step further than the process skills e developed by laboratory learning or normal (exercises) practical work. Inquiry learning gives the learners the insight of real scientists. They perceive the phenomena, investigate them and record observation, and bring forth conclusions or findings with respect to particular phenomena. In real life, this is how scientists work.

2.6.3 Group Discussion

Group discussion is the instruction strategy used to facilitate cooperative learning in the classroom. It occurs when two or more learners are asked to work together. Woods (1996) states that students learn better if this method is used because they are actively involved during lessons. Learners do not become passive creatures during lessons when group discussion is used. If group work is used properly it can have the following advantages in the class.

1. It shifts focus from individual learner and places it on the group.
2. It makes learners to be active in the class and not just passive recipient of the information, consequently it enhances learners' achievement and retention.
3. It encourages learners to verbalize their ideas, feelings and experiences as a result it can help them to understand the subject matter better.
4. It encourages learners to concentrate on clear communication and thus enhances their metacognition; they learn to think and communicate better.
5. It can be very helpful in improving learners' problem solving skills. Learners work better if they tackle problems as group members than as individuals. This also helps them to realize that there are multiple strategies and solutions to problems.
6. It could be a useful way of activating learners' prior knowledge and help them to construct their understanding of subject mater.
7. It gives all earners the opportunity to contribute ideas and try to master the content in a non-threatening environment.
8. It allows learners to experience roles as leaders, peers, subordinates and followers and thus experience the range of social context. (Killen, 2007, p. 169)

I realized that a teaching method known as a **generalized teaching scheme** (Needham, 1987) is suitable for this instructional strategy. This method involves five learning phases and they are the orientation phase, elicitation phase, restructuring phase, application phases and review phase (Needham, 1987). In the orientation phase the teacher arouses interest from students so as to set the scene for learning. This could be done by posing a problem or performing a small demonstration or by giving initial practical work. In the elicitation phase the teacher seeks to find out the prior knowledge of student. This could be achieved by asking questions that link to prior knowledge. In the restructuring phase students are allowed to discuss the concept or phenomenon. In this phase students come to know about the alternative view points of the concept as the discussions continue. They may come across conflicting ideas about the concept or phenomenon and are allowed to discuss and test the validity of their ideas. From this discourse learners

construct their knowledge by modifying, extending or replacing their prior knowledge with more valid ones. In the application phase the constructed knowledge is reinforced through written work, exercises, activities, problems to be solved or with further question and answer session. In the review phase learners are made aware of change of ideas through more discussions, report back and feedback from the teacher or other students. This model is also known as the Children Learning in Science Model (CLIS) and bears international application.

I have noticed that in most cases the tasks in CTAs require that learners should work in groups. Learners have to discus, debate, argue and present their findings. Learners have to assess themselves and assess each other. This then being the case with CTAs means that group work should be among strategies employed in the class. The use of group work is therefore consistent with aims and objectives of CTAs.

2.6.4 Projects

A project refers to the work generated and engineered by students themselves at their own and in their spare time. Other people refer to projects as students' products (Sternmark, 1989). These include design and invention, investigations and compiling of laboratory reports, physical construction of models, bulletin boards, conference presentations, dramatic performance, producing audio-visual tapes, producing computer demonstrations, preparing quiz questions and symposiums, designing puzzles and chats, creating scientific art etc. (Sternmark, 1989). Projects have a variety of advantages in their uses for assessment, and some of them are the following:

(i) They indicate understanding of learned concepts.

(ii) They show originality that goes beyond what has been taught.

(iii) They indicate a success in meeting outcomes determined prior to engaging learning activities.

(iv) They indicate the skills and attitudes that are not reflected in a standard test.

(v) They provide a bridge between classroom and real world situations.

(vi) They give learners more flexible time to do thoughtful work.

(vii) They bring real life to education, thereby making it more interesting.

(viii) They engage students who are not enthusiastic about school work.

(iv) They facilitate creativity and critical thinking.

(ix) They demonstrate to the community what students can achieve in real world situations (Stenmark, 1989, p. 6).

The ability of producing projects and using them to solve problems is assessed in CTAs, e.g., in 2009 CTA students were required to make paper cup anemometer and use it to determine which area in their school yard has the fastest wind, and hence decide where in their school yard can a wind turbine be installed. The use of projects in Natural Science Learning Area is therefore consistent with CTAs.

The list of the advantages of projects in science education is almost endless. Only few are cited here to show the importance of projects in the teaching and learning of science.

2.6.5 Field Trips

Field trips are out-door activities that are organized for learning purposes e.g. visit to a zoo, park, game reserve, environmental centers, science exhibitions, industries etc (Hofstein and Walberg, 1995). Both the teacher and students should be well prepared for the field trip, e.g. there should be worksheets to be filled while on the trip. Field trips become more successful if the places visited are familiar to the teacher. Also, students should be given clear objectives of the field trip.

Field trips take place in a more open space and with very little teacher sanctions, as a result students are more flexible in field trips. Students are able to move around in their own pace in field trips, so they can explore more on their own. Field trips can provide students with concrete experience which is unavailable in the classroom. Field trips provide an alternative to normal classroom setting therefore they can be very useful in boosting morale and motivation of the learners. The research carried out by the Science

and Environmental Council of Sarasota County (2007) found that students who are occasionally taken to science field trips demonstrate better attitude towards science than those who are not taken to field trips. This means that field trips increase students' interest in science.

The field trips benefit students more if the teacher:

(i) Has a thorough understanding of the topic that will be experienced in the field trip.
(ii) Has an input on the design of the programs that will be followed in the field trip.
(iii) Has received a pre-program orientation about the programs that will be followed in the field trip.
(iv) Has provided the students with the objectives and the activities that will be carried out in the field trip.
(v) Explains the structure of the day's proceedings and the nature of the environment of the field trip.
(vi) Engages the staff members of the institution visited or running the program sessions.
(vii) Encourages explanatory talk and discussions between the students.
(ix) Gives out hand-out to be filled by students in the field trip.
(x) Reviews and recalls the visit and ideas experienced in the field trip later in the year. (Science and Environmental Council of Sarasota County, 2007, p. 14)

In CTAs learners are sometimes required to go outside and observe natural phenomena in the field, e.g., in 2005 CTA learners were required to go outside to observe and collect the leaves of different plants. They were also asked to take the note of the area where the particular plants are found so that they could deduce the suitability for plants with certain types of leaves to survive in a particular area. This could not be achieved in the classroom, so field trips was necessary. We can now see that the use of field trips in the year is necessary so as to prepare the learners for such situations in the CTAs. Field trips are consistent with CTAs.

The instruction strategies given above are incorporated in the CTAs. If it's true that CTAs influence teachers' practices, teachers will more and more engage these or some of these strategies in their lessons as one of the outcomes of my study will demonstrate. These strategies are engaged when promoting critical thinking and problem solving in the class.

2.7 Theoretical Framework

A theoretical framework can be described as "a well-developed coherent explanation for an event" (Vithal and Jansen, 2005, p. 17). It is an orientation or sweeping way of seeing and thinking about the social world (Neuman, 2006). It provides assumptions, concepts and forms of explanations in a research. A theoretical framework locates the research, i.e., it signals where the research comes from and where it is heeding to. It serves as an analytic tool for the study. I have chosen constructivism and problem solving as framework to inform my research. In my research I investigated the influence of CTAs on teachers' pedagogical practices. CTAs are governed by OBE philosophy so they are influenced by constructivism since constructivism is a key rationale for OBE. When teachers use constructivism as a referent they usually use problem-solving as a learning strategy. It is under this light that I chose constructivism and problem solving as my theoretical framework.

Constructivism "is the active process of constructing or putting together of conceptual framework or reality" (Cobern, 1995, p. 11). It is an epistemology (a theory of knowledge) used to explain how we know and what we know. Constructivists state that knowledge is a construction of how the world works, one that is viable in the sense that it allows an individual to pursue particular goals. According to constructivists, reality is not something "out there" and independent of human consciousness. Constructivist researchers hold the following values:

1. Reality is represented through the eyes of participants. The existence of an external reality independent of people's theoretical beliefs and concepts is denied.

2. Research process is viewed as generating working hypotheses rather than immutable empirical facts.
3. The attitude towards theorizing emphasizes the emergence of concepts from data rather than the imposition in terms of a theory.
4. The role of language is emphasized, both as an object of study and as the central instrument by which the world is represented and constructed.
5. Scientific accounts and theories are not accorded a privileged position; they are equivalent to other accounts.
6. It is not accepted that there are rational criteria for choosing among different theoretical frameworks or explanations; moral, aesthetic or instrumental values or conventions always play an essential part in such choices. (Robson, 2002, p. 25)

These values guide constructivists' researchers and my research was guided by them.

Constructivism can be classified as into radical constructivism, cognitive constructivism and social constructivism (Killen, 2007). Radical constructivism holds the following four principles:

1. What a person knows is not just received passively but is actively constructed by the individual.
2. Knowledge is the result of personal interpretation of experience, so one person's knowledge cannot be totally transferred to another person.
3. The cultures and societies to which people belong influence their views of the world.
4. The construction of ideas is aided by systematic, open-minded discussions and debates. (Killen, 2007, p. 7)

These principles imply that individuals need time to experience, reflect on their experiences in relation to what they already know, and resolve problems that may arise. Individuals need time to clarify, elaborate, describe, compare, negotiate and reach consensus on what specific experiences mean to them.

Cognitive constructivism focuses on the cognitive processes that people use to make sense of their world. This implies that while constructing their world, the individuals select the information they perceive to be relevant to them and they interpret this on the basis of the knowledge they already poses. A person learning a new concept therefore brings his previous experiences to help him to make sense of the new knowledge.

Social constructivism takes into cognisance that knowledge is a social reality shared by a society. Social constructivists view learning as a process whereby individuals acquire knowledge by interacting with their environment through psychological tools of their culture. These psychological tools of culture could be language, mathematics, technology, science, diagrams, problem solving, etc.

Although constructivism can be classified into different classes but the common denominator among them is the constructivist philosophy. i.e., a belief that individuals develop understanding when they are active and seek reality for themselves and that the knowledge originates from inside.

CTAs are underpinned by constructivist philosophy, especially Section A. CTAs require that learners should be active in the class and they should construct reality for themselves. In most cases CTAs require that learners should seek information, discus it in groups, present their findings, argue or debate about their findings, defend their findings, assess themselves and assess other students. These are postulations advocated by constructivism. As these are also common to CTAs it means CTAs are influenced by constructivist philosophy.

During CTAs sessions learners are involved in practical work and investigations. Sometimes they have to go outside to observe phenomena or to seek information. They sometime produce items that they can use to seek further information. In this way learners are very busy constructing knowledge. In the class during CTAs session students

are not passive learners waiting to receive information or knowledge from transmitter teacher. They are busy constructing knowledge so CTAs are constructivist oriented tasks.

Another theoretical framework that I considered is problem-solving. Problem solving can be defined as "a multifaceted cognitive activity in which we engage when we are confronted with the task in which routine action or normal thinking does not allow us to go from the given situation to the desired goal, but rather there is recourse to some form of critical thinking" (Hobden, 2005, p. 2). Other definition describes problem solving as "a situation in which a goal is to be attained and a direct route to the goal is temporarily blocked" (Barba, 1990, p. 32). Watts (1994) argues that problems are necessary in education so as to motivate the students to learn, to develop understanding of the subject matter, to increase self confidence, to stimulate interest and critical thinking and to develop general problem solving skills. Problems generate curiosity in the class, promote intellectual activities and develop physical skills. Problem contexts in the classroom include curricula activities, practical work, everyday life experiences, environmental issues, social issues, commercial situations and cross-disciplinary situations (Wheatly, 1995). Watts (1994) stated that good problems have clear and unambiguous goals, have possible solutions which challenge and motivate the students to learn, and promote creativity.

Schoenfield (1985) suggested that problem solvers should be equipped with framework (knowledge and behaviour) necessary for solving problems. The four categories of problem solving framework are:

1. Resources
2. Heuristics
3. Control, and
4. Belief systems.

Resources are the body of knowledge that the individual brings forth to tackle problems. These could be factual, procedural or propositional knowledge the individual possesses. This includes formal and informal knowledge regarding the domain, facts and principles of the domain, algorithm procedures, non-algorithm procedures and the understanding of the rules of the domain.

Heuristics are the rules of thumb necessary for effective problem solving. This refers to the wide spectrum of strategies necessary to help a person to make a move or progress when faced with unfamiliar situations. These strategies include things like the use of diagrams, figures or drawings; the use of alternative representation of the problem like equations, graphs, charts and maps; introducing suitable notations like reformulation of the problem, breaking the problem into simpler components, looking for patterns, working backward and forward, trial-error strategy; and testing and verifying the procedure.

Control refers to the allocation and management of resources during problem-solving process. This includes decision making regarding planning, monitoring and assessing the solution strategy. Control involves questioning the solution strategy and evaluation of the procedures involved in the solution. Good control system assists problem solver to make most of their resources and thus become a good problem solver.

Belief systems refers to the views, perspectives and approaches one brings to the problem. A person brings beliefs like positive attitude, subject matter, motivation, problem solving ability, courage, perseverance, patience, etc. The beliefs determine one's success or failure in problem solving. Beliefs establish the context within which resources, heuristics and control operate. The manner in which a person approaches the problem and chooses solution strategy is informed by beliefs.

There are many methods used by teachers to teach problem solving. The most common ones are osmosis, memorization, imitation, cooperation and reflection (Barba, 1990). When teachers use osmosis they expose students to problem solving atmosphere and

believe that they will absorb problem solving skills. In memorization method students are encouraged to memorize the rules and algorithms used in problem solving. In imitation the teacher demonstrate the problem solving on the board and encourage the students to watch attentively so that they can learn the skills of solving problems. In cooperation students are placed in small groups and are allowed to solve problems as group members. In this way students learn on their own problem solving skills (Watts, 1994). In reflection students are urged to use heuristics or metacognitive prompts to solve the problems and then asked to reflect on their strategies. I hope constructivism and problem solving will help me to interpret and understand the attitude of teachers' toward CTAs.

2.8 Conclusion

In general, the literature shows that assessment influences and informs teachers' practices. It influences the use of instructional strategies in the classroom, e.g., Klassen, 2006; Stern and Ahlgren, 2002; Bell and Cowie, 2001; Ebel, 1998. Assessment also influences the performance of learners in various subjects, e.g., Steadman, 1998; and Soetaert 1998. The literature does not though state whether CTAs, as an external assessment in Grade 9, influence teachers' practices, e.g., Poliah, 2003; and Wilmont, 2005. In this study I investigated whether CTA's, as Grade 9 external assessment, influence teachers' practices or not, and if they influence them, how? My methodology chapter will serve to demonstrate how I investigated CTAs in this respect through the research method described for the study.

CHAPTER 3

RESEARCH METHODOLOGY

Before a person can start collecting data for a study, he/she should have a plan i.e., research methodology or strategy to enable him/her to do so. My research strategy aims to find answers to my research questions posed in Chapter One. It is designed with the intention of using approaches which yield a multiplicity of data revelations that will enrich my analysis of the implementation of CTAs and their influence on teachers' practices of the new curriculum.

3.1 Methodological Approach

I have used an interpretive paradigm in my study. An interpretive pardigm is "the systematic analysis of socially meaningful actions through the direct detailed observation of people in natural settings in order to arrive at understandings and interpretations of how people create and maintain their social worlds" (Neuman, 2006, p. 88). The interpretive researcher tries to understand the human experiences in a subjective way (Cohen, Manion and Morrison, 2000). This means that the researcher tries to understand the phenomenon from the perspective of those people who live or interact with it, and this is known as emic perspective (Gall, Borg and Gall, 1996). An interpretive researcher's goal is to understand the social life of humans and discover how they construct meaning in their natural settings, i.e., they will seek to learn what is meaningful or relevant to the subjects. Interpretive researchers don't just study the external behaviour of the participants but seek to find the meaning of social actions as presented by the subjects.

As far as reality is concerned, the interpretive researcher does not see reality as "something out there" waiting to be found and independent of human consciousness. According to interpretive researcher, the reality is a social world largely perceived by people to be what it is (Neuman, 2006). The reality depends on social interactions

constructed by people living it, i.e., it is based on the definitions assigned by people on it (Robson, 2002). The interpretive researcher reckons that social situations are ambiguous, so it is not easy to discover straightforward objective facts. In most cases social behaviours tend to have several meanings and can be interpreted in multiple ways (Neuman, 2006). The interpretive paradigm supports the idealist theory of knowledge, the idea that states that data collection should not be confined to observable behaviour only, but should also include descriptions of people's intentions, meanings and reasons (Babbie, Mouton, Vorster and Prozesky, 2007). The above ideology is consistent with constructivist theory. As I have chosen constructivism as my theoretical framework interpretive paradigm is therefore suitable for my study.

3.2 Research Design

The method that I used in my study is referred to as the mixed-mode method. A mixed-mode method is a research approach in which more than one method of data collection is used. A mixed-mode methodology involves triangulation. Triangulation is defined as "the use of two or more methods in the study of some aspects of human behaviour" (Cohen *et al*, 2000, p. 112). The advantage of using triangulation is that it exposes a multiplicity of perspectives on social behaviour or situations. I used quantitative and qualitative techniques in my study, so I used a mixed mode approach. In this study I was investigating a human behaviour, and it is a very complex phenomenon. One cannot emphatically say that the results obtained from such study yield sufficient and unambiguous information. In such a case the use of more than two methods of data collection is desirable. I used triangulation because the use of two or more techniques can help to reduce or indicate data collection error. For an example, if the results from quantitative techniques do not tally-up with results from qualitative techniques, this would indicate that there is an error in the data or in the analysis. Triangulation can help to reduce the error in the study and enhance the validity and reliability of a study. In my study I first used quantitative techniques and then followed up with qualitative techniques. Such an approach is referred to as methodological triangulation (Cohen *et al*, 2000).

I preferred to begin with a quantitative technique because it would help paint a broader picture of the phenomenon. A quantitative research approach is "a research strategy that describes a phenomenon in numbers rather than words" (Krathwol, 1993, p. 740). Babbie *et al* (2007) stated that the three features characterizing quantitative research are: (1) An emphasis on the quantification of constructs, (2) the emphasis on variables in describing and analyzing human behaviour, (3) the central role afforded to control for sources of error in the research process. There is numerical representation and manipulation of observations for the purpose of describing and explaining the human behaviour in quantitative research. I gathered data from 32 schools (those that brought back the questionnaires) using the survey method. A survey is a "research strategy that involves the structured collection of data from a sizable population" (Saunders, Lewis, and Thornhill, 2003). This strategy allows researchers to gather large scale data and thus make realistic generalizations (Cohen *et al*, 2000). Quantitative research is rigid, objective and neutral and this minimizes bias in both the researcher and subject. It explains human actions in terms of monological (straight forward) principles and therefore it simplifies the reality. The survey strategy gives a researcher more control over the research process (Saunders *et al*, 2003). It works within a value free environment, i.e, it gathers context free data (Cohen *et al*, 2000), because the researcher and subject are distant in the survey. Quantitative research gives the numeric description of trends, attitudes and opinions of population and thus provides a good over view of the phenomenon.

The Quantitative research has weaknesses of its own. It research emphasizes the measurement and analysis of causal relationships between variables and does not pay more attention on the process. It does not get close enough to the perspective because of the remote inferential method used in it. In this way it silences many voices. It avoids the everyday social world and rather opts for the study of large numbers of randomly selected cases. Also, it does not keep up with the rapidly changing social context, It takes a lot of time designing and piloting the questionnaires, and also takes a lot of time analyzing the results gathered with questionnaires (Saunders *et al*, 2003). The data collected with a

survey might not be as wide as that data collected using other strategies. To me it seems as if it is advisable to couple a quantitative strategy with other strategies so as to ensure the validity and the reliability of the study.

Another strategy that I have used in my research is a qualitative strategy. A qualitative research approach is "a generic research approach in social research according to which research takes its departure point as the insider perspective on social action" (Babbie *et al*, 2007, p. 646). Qualitative research attempts to study human actions from the insiders' point of view, also referred to as emic perspective (Gall *et al*, 1996). It is based on the notion of sensitivity, the belief that a particular phenomenon has a great bearing on human behavior (Smith, 1987). Qualitative research is characterized by non-numerical examination and interpretation of observations. The goal of the qualitative research is to understand or describe the human behaviours rather than explaining or predicting them. The methods emphasized by qualitative research are methods of observation and analysis that come closer to the subjects, e.g., case study. Case study method involving interviews is suitable for qualitative research. I have used the case study approach to collect data for qualitative analysis in my study. A case study is "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life evidence" (Robson, 2002, p. 178). In a case study the observation of the characteristics of an individual unit, a class, a clique or a community is employed. It is undertaken to probe deeply and analyze intensively the multifarious phenomenon of the individual unit with the view to generalizing the population to which the individual unit belongs (Cohen *et al*, 2000). Nisbet and Watts (1984) stated that a case study is a commendable approach because it is easily understood as it is written in everyday language, it speaks for itself, it catches unique features that are lost in large scale quantitative data. Case study is also strong on reality, can embrace and build in unanticipated events and uncontrolled variables, and can be undertaken by a single researcher. They also highlighted the weakness of a case study. They stated that its results may not be very generalizable because it concentrates on very few individuals. Also, a case study is not easily open to cross – checking, hence it may be selective, biased,

personal and subjective. In my case I don't think it will be so because I used more than one method of collecting and analyzing data.

While I was selecting my sample, I thought about the generalizability of the study. I derived the sample for my study from various places of Ethekwini region, not just on one particular area. I did this so that my sample will cover a wide spectrum of Ethekwini region. For quantitative method, I sent the questionnaires to teachers in all districts of Ethekwini region. I sent questionnaire to teachers in Umlazi district, Pinetown district and Ilembe district. I chose the sample from such wide spectrum area so that my sample can represent most of the teachers in Ethekwini region. The respondents in my sample come from urban schools, township schools and rural schools. I believe that such a sample will represent most teachers at Ethekwini district and therefore the findings of my study can be generalized to Grade 9 Natural Science teachers in Ethekwini region..

3.3 Data Collection Method

I decided to use two data collection instruments, i.e., questionnaires and interviews. To me these are the best methods of collecting the data for research such as mine. Questionnaires can involve a large number of people, even those who live in far places, thus can help the researcher to save on travelling expenses. Interviews can yield a great deal of useful information and even the one that the researcher hadn't planned to ask. I mailed 80 questionnaires to Grade 9 Natural Science teachers and gave myself six weeks for them to be returned. I hoped that at least 60% (i.e. 48) of the questionnaires would come back. I intended to analyze 50 or more questionnaires. Other questionnaires were to be administered to persons who would be interviewed. Cohen *et al* (2000) said at least 30 questionnaires are sufficient to give a reasonable picture of educational phenomenon. In my study I interviewed five Grade 9 Natural Science teachers. The research instruments that I used to collect the data in my study are discussed below.

3.3.1 Questionnaires

The first instrument that I used to collect the data in my study is a questionnaire. A Questionnaire can be described as "a technique of data collection in which each person is asked to respond to some set of questions in a predetermined order" (Saunders *et al*, 2003, p. 280). I prefer to use questionnaires because they can give a reasonable amount of information in a short space of time. Questionnaires can be easily administered. They can be personally delivered to respondents, (self-administered questionnaires). They can be delivered and returned electronically using e-mail or internet, (on-line questionnaires). Also, they can be posted to respondents to complete and return them by post (postal questionnaires). In my study I used postal questionnaires. I chose schools from the database of schools in the Ethekwini region which is obtainable from the Department of Education of KwaZulu-Natal. I chose schools form rural areas, townships and urban areas. I hoped that such a cocktail of schools would cover a wide spectrum and hence would give me a broad picture of how CTAs influence pedagogical practices of Grade Nine science teachers in various areas. The questionnaires sent to schools were addressed to Grade Nine science teachers and were accompanied by a covering letter and a self addressed and stamped envelopes. Follow-up letters were sent a week later after the questionnaires had been mailed so as to remind the teachers to complete the questionnaires timeously. Second follow-up letters were sent three weeks later. I gave myself six weeks for the questionnaires to be returned subsequent to analyzing them.

Bell (1999) stated that there are problems associated with questionnaires. The most common problem is the non-response. In my case I tried to reduce this problem by including self-addressed and stamped envelopes so that the respondents would not incur expenses of mailing back the questionnaires. In this way I hoped to reduce the non-response tendency associated with questionnaires. I coded questionnaires so that I could track down the non-response persons in my list. I then wrote second and eve third follow-up letters to non-response persons. I tried by all means to motivate the respondents to complete the questionnaires.

Another problem associated with questionnaires is misinterpretation of questions Neuman (2006) gives the principle of writing good questions for questionnaires and they are as follows:

(i) Avoid jargon, slang and abbreviation.
(ii) Avoid ambiguity, confusion and vagueness.
(iii) Avoid emotional language and prestige bias.
(iv) Avoid double barreled questions.
(v) Avoid leading questions.
(vi) Avoid asking question s that are beyond respondents capabilities.
(vii) Avoid false premises.
(viii) Avoid asking about future intentions.
(ix) Avoid double negatives.
(x) Avoid overlapping or unbalanced response categories. (p. 282)

I kept these principles in mind when designing my questionnaires so that I could minimize the chances of misinterpretation in my questionnaire, see Appendix A. I used structured and semi – structured questions in my questionnaires (Cohen *et al*, 2000). I used various types of questions in my questionnaire. I used dichotomous questions, rating scale questions, close-ended questions and open-ended questions in my questionnaire (Neuman, 2006). On teachers' perceptions on CTAs, I used dichotomous questions. On school profile I used multiple choice questions. On teacher support, learner characteristic and frequency of giving work I used a rating scale (Likert scale). On teachers' experience and in-service training I used open-ended questions.

The questionnaire consisted of 8 sections. Section 1 dealt with gender and teachers' qualifications. This investigated whether gender and teachers' qualifications influence teachers' views on CTAs. Section 2 dealt with teaching experience. This would serve to investigate whether there is a correlation between teaching experience and CTAs' influence. Section 3 dealt with inservices training. CTAs were introduced when the new curriculum (OBE) was introduced. When a new curriculum is introduced inservice

trainings are necessary. The influence of CTAs on teachers' practices could therefore be influenced by the inservice training that the teachers attended. Section 4 dealt with schools' profiles. I wanted to know what type of school each respondent come from. This would help me to understand more about his / her responses and how do CTAs influence teachers' practices with respect to school' profiles. Section 5 dealt with the support the teachers get from their schools. The support given to teachers may influence their attitude towards CTAs and I wanted to know to what extent does the support influence the attitude toward CTAs. Section 6 dealt with learners' characteristics. Teachers' attitudes or practices are sometimes influenced by learners' behaviour. CTAs are set for learners and are written by learners, so learners' behaviour (characteristics) may influence the teachers' attitudes toward CTAs. Section 7 dealt with the frequency of giving certain types of work to learners. The work looked into here is in accordance with the outcomes and abilities assessed by CTAs. This would help me to identify which teachers' practices or strategies are influenced by the CTAs. Section 8 dealt with the teachers' perceptions or views on whether CTAs influence teachers' practices and if they do, which practices are influenced the most? Section 8 and section 7 are closely related. The results from these sections were looked into concurrently to see if they tally-up. If they tally-up that would mean that the research findings are valid.

3.3.2 Interviews

Another instrument that I used is an interview schedule. My interview questions are presented as Appendix B in this dissertation. An interview can be defined as "a conversation between interviewer and respondent with the purpose of eliciting certain information from the respondent" (Moser and Kalton, 1971, p. 27.). I used semi-structured interviews in my research. A semi-structured interview can be viewed as "an interview where a researcher is not limited to standard structured questions only, but may follow with one or more individually tailored questions to get clarity or probe a person's reasoning" (Leedy and Ormrod, 2005, p. 184). I prefer semi-structured interviews because there is room for flexibility in them. Such interviews do not only depend on pre-designed and phrased questions, since some of the questions can arise incidentally from

the interview. These are referred to as probe questions. Flexibility is therefore necessary in interviews so as to allow for probe questions. Probe questions can give more details of the phenomenon under speculation, i.e., the influence of CTAs on the pedagogical practices of Grade 9 Natural Science teachers. Semi-structured interviews focus on the participants' subjective responses to a situation in which they are involved. Semi-structured interviews therefore produce more valid information. Semi-structured interviews are less intrusive to the interviewees because they allow for a two-way communication. The interviewees can also ask questions from the interviewer and thus function as an extension tool. The information obtained from the semi-structured interviews therefore does not only provide answers but also the reasons for answers, i.e. they can be open-ended.

Like any other research strategy, semi-structured interviews also have problems of their own. An interviewee might not be at ease with the interview. To counteract this I allowed the conversation to be as natural as possible (Walford, 2001). I interviewed participants in venues where they felt that they were comfortable, e.g. in their homes. If they felt that the participants were not comfortable, I tried to make the scene appear to be informal so that the participants would feel comfortable and relaxed, e.g. like cracking a joke.

In the semi-structured interview, the researcher might interfere with the gathering of information and this could lead to bias. Bell (1999) stated that there is a danger of an interview becoming a reflection of what the interviewee thinks what the interviewer wants. A participant might tend to give the information that they think the interviewer wants and not the total truth. In my case I explained to the participants that they should give me the absolute truth.

Another problem faced by a person conducting interviews is the ethical dilemma (Neuman, 2006). An interviewee might not trust that his/her responses will be confidential and that his/her anonymity will be protected. I explained to my participants that I had a moral obligation to uphold the confidentiality of data and that I had signed an ethical clearance form that binds me in upholding their anonymity. I showed the

interviewees my ethical clearance form and my ethical clearance letter when I requested them to participate in my research. I gave them the consent letter which explained the objectives and nature of the research and my obligation to uphold their anonymity and autonomy in the research. I hoped that would help ease their feelings. I gave them the informed consent form that guarantees their anonymity and confidentiality. I also presented transcripts of interviews to them to verify the authenticity, i.e., to show that I quoted them correctly.

The third problem faced by the interviewer is that of non-maleficent behaviour, i.e., the belief that the interview will not be to the advantage of the participant and that it will not harm him/her (Cohen *et al*, 2000). I assured my participants that when publishing the findings of the research I would not use their real names or their schools' names, but I will use pseudonyms, i.e. false names. I also told them that they would be given the findings of the research so that they would also benefit from the outcome of the research.

The instrument for interview schedules consisted of 15 questions. It covered the purpose of CTAs, the administration of CTAs, teachers' views on CTAs, critical thinking and problem solving, practical work and investigations, projects and field work, and self and peer assessment. It also ascertained whether the employment of these practices and strategies in the classroom are influenced by CTAs. The interviews sought also to find out the problems encountered with CTAs in schools and how could these problems be addressed. The stories from the interviews were recorded on tapes and the tapes were transcribed into written text. The stories from the interviews appear in pages 91 – 106.

3.4 Sampling Procedure

I used non-probability samples in my study because I was doing small scale research. Also, this procedure is less complicated and less expensive. The non-probability sample type that I used in my research is convenience sampling. Convenience sampling is the process that involves choosing the nearest individuals to serve as respondents and continuing the process until the required sample size is obtained (Cohen *et al*, 2000). I

chose this method because of constraints that I was faced with in my research. Firstly, I did this study on a part time basis because I am working as a full time employee. I didn't have the luxury of time to use time consuming methods. Secondly, I didn't have a sponsor paying for my study. I financed my study from my salary and I didn't have sufficient funds to pay for expensive methods.

The sample was derived from teachers teaching in the Ethekwini region. I selected the sample from teachers in the Pinetown and Umlazi districts. I chose these districts because they have rural, urban and township schools. Teachers from such areas would give me sufficient diversity for my finding to be generalizable to a wider population. I sent questionnaires to 80 Grade 9 Natural Science teachers by post and hoped that about 60% of them (i.e. 48) would return back the questionnaires. I also held interviews with 5 Grade 9 Natural Science teachers. I would also ask some of the interviewees to complete the questionnaires and this would bring the sample size to 50 or more.

My sample was limited to a small number of respondents because of the time constraint that I was faced with when doing my study. I did the study on part-time basis because I am a full-time employee, so I didn't have the luxury of time to collect the data from many respondents. But I still hoped that my sample size was reasonable enough to give me the valid and reliable findings for the research. The findings from this sample could be generalized to a population of teachers in the Ethekwini region only. This sample size was sufficient to guarantee population validity although it might not be sufficient for ecological validity of the whole population of Grade 9 Natural Science teachers in South Africa because the sample size is small and it comes from one area in KwaZulu-Natal. I thought that this sample was sufficient for the study to be trustworthy because it covered many places within the Ethekwini region. It covered rural areas, township areas and urban areas.

3.5 Data Analysis Method

The purpose of my research was to investigate the influence of CTAs on the pedagogical practices of Grade 9 Natural Science teachers. I wished to determine what influence do CTAs have on the pedagogical practice of Grade 9 Natural Science teachers. I believe that the influence of CTAs on teachers' practices could be affected by many other things. These other things that could affect the influence of CTAs on teachers' practices are referred to as intervening factors. An intervening factor can be looked at as the factor that influences the cause of effect to a phenomenon. The intervening factors in my study included gender, teaching experience, support received by teachers in their schools, schools profiles and learners' character. To determine whether these intervening factors affect the influence of CTAs on teachers' practices I decided to use bivariate statistical analysis. Bivariate statistical analysis is "the analysis of variables simultaneously for the purpose of determining the empirical relationship between them" (Babbie *et al*, 2007, p. 640). I used bivariate statistical analysis so as to determine if there is any correlation between these factors and CTAs influence. I used Pearson' correlation coefficient to investigate the interrelationship between these factors and CTAs influence. In other words I used a covariation method. Covariation "is the idea that two variables vary together such that knowing the values of one variable provides information about the values of another variable" (Neuman, 2006, p. 353). I also used percentage tables and statistical calculations in my analysis. In statistical calculations I determined the mean, mode, median, standard deviation, and skewness of the data so as to decide whether the results of data analysis are trustworthy.

After I collected the returned questionnaires I constructed a raw data table. I coded the data before entering it into the table. This raw data table is referred to as a Coded Data Table, and its structure is shown in Table 3.1 below. My Coded Data Table consists of eleven columns. The items in the table are case number, gender, teaching experience, inservice training, catchment area, class size, resources, support, learners' character, strategy mostly used and work influenced by CTAs. The strategy used frequently was deduced from the work given frequently to learners. This is found in section 7 of the

questionnaire. The high score in the category denoted that the particular strategy is used the most and the low score showed that the strategy is used the least. This would show which strategies are influenced by CTAs the most. The scores were entered in column 10 in the Coded Data Table. Section 8 of the questionnaire dealt with the teachers' views on whether CTAs influence teachers' practices. The scores for individual teachers' views were entered in column 11 in the Coded Data Table. This indicated which categories of work or strategies are influenced by CTAs. From this I calculated the percentage of teachers influenced by CTAs and thus determined to which extent do CTAs influence teachers' practices. The following figure shows the structure of the Coded Data Table.

1	2	3	4	5	6	7	8	9	10	11
Case	Gender	Teaching Experience (in years)	Inservice Training	Area Type	Class Size	Resources	Support	Learners' Character	Strategy Mostly Used	Influence Of CTAs On Work

Table 3.1 Coded Data Table Structure

I used a coding system so that it could be easy to analyze the data (Merriam, 1998; Nueman, 2006). As said before, there are 11 columns in the Coded Data Table. I entered the case numbers of respondents in column 1. As there are 32 respondents, the case numbers start from 1 and end at 32. I entered the gender data in column 2. I used 1 for male and 2 for female. Column 3 served as experience column. The number of years served as a teacher by each respondent was entered in column 3. Column 4 was used for inservice training data. The number of inservice trainings the particular teacher attended was entered in column 4. Column 5 dealt with catchment area data. I used 1 for rural area, 2 for township area and 3 for urban area. Column 6 dealt with class size data. I used 1 for less than 30 students in a class (small classes), 2 for classes with students between 30 and 50 (normal size classes) and 3 for classes with over 50 students (crowded or big classes). Column 7 was resource availability column. I used 1 for poorly resourced schools, 2 for marginally resourced schools and 3 for well resourced schools. Column 8 showed the support the teachers received in their schools. I calculated the aggregate score for each teacher (section 5 in the questionnaire) and entered the data in the table. I did the same with column 9 (learners' character column) and also with column 10 (strategy used

the most). Column 11 dealt with the influence of CTAs on teachers' practices. This was measured using 10 categories of work promoted by CTAs. Teachers had to indicate which categories, out of 10, were influenced by CTAs. The number of categories chosen was entered in the Coded Data Table for each respondent and from this I could deduce how CTAs influence teachers' practices and which practices are influenced the most.

After analyzing the questionnaire I analyzed the interviews. I first listened to the tapes and then transcribed the interviews in the tapes into the written language. These became the data that I used for my qualitative analysis. I listened to the tapes again and again after transcribing them. I then wrote the interviews in a narrative way based on what the participants said. I also used quotes from the transcripts as key evidence of claims, see Qualitative Analysis in Chapter 4. I used the interviews because they would give me a clearer picture of the phenomenon, i.e., the influence of CTAs on pedagogical practices of teachers. The interviews would help to throw more light on the results obtained from analyzing questionnaires. I then wrote the summary of each interview. I clustered the units of relevant meaning, i.e., I put similar units together for further analysis. I then determined the theme of cluster meanings. I looked for the attitudes, values, opinions and beliefs of the participants and checked if they answered my research questions, i.e., I delineated units of meaning relevant to the research questions. I then wrote the composite summary which gave me the overall picture of the phenomenon, i.e., the influence of CTAs on pedagogical practices of Grade 9 Natural Science teachers.

3.6 Ethical Considerations

Ethics in research refers to the appropriateness of a researcher's behaviour in relation to the rights of respondents. Researchers have to abide by the codes of ethics when carrying out their studies. The code of ethics is the statement of principles and procedures to be followed when conducting research so as not to violate the rights of the respondents. Some of the common ethical dilemmas associated with research are privacy, anonymity, confidentiality and deception (Cohen *et al*, 2000).

People have the right to privacy and this right should be respected. Sometimes researchers invade people's privacy. They ask questions that will need people to reveal their secrets. In my study there is no part that required respondents to relinquish their right to privacy. My study did not require me to probe into people's private affairs. It only concerned the pedagogical practices of the teachers so it did not invade people's private affairs.

Anonymity refers to non-identification of the respondent in the research (Cohen *et al*, 2000). This means that a response could not be associated with a certain respondent. The anonymity of respondents is limited to a certain extent in interviews. However, I did not use real names of the respondents in my study so that their real identity could not be disclosed. In the research report I only used pseudonyms for the names of participants in my research. In this way the anonymity of respondents was safeguarded.

Confidentiality refers to the trustworthiness of the researcher and also non-identification of the respondents (Cohen *et al*, 2000). The respondents should have faith in the researcher that the information given in good faith would be handled in such a way that it would not expose them. To ensure this I safeguarded the data such that no unauthorized person could have access to it. I kept the data under lock and key. The tapes and questionnaires were kept in my safe.

Deception refers to dishonesty or untruthfulness of the researcher (Cohen *et al*, 2000). Sometime researchers lie to the participants. They don't give the true purpose of the research or they lie about confidentiality and anonymity. In this way participants are deceived or cheated. I did not betray the trust of my participants because I honored what I said during the interviews about their anonymity and confidentiality. I also presented the transcripts of the interviews to them to validate their information. All the participants approved my transcripts as being a correct reflection of my interviews with them.

To comply with the ethical code I did the following:

(i) I explained to the participants that their participation was voluntary. I gave them the consent forms which they signed to indicate that they were told that their participation was voluntary.

(ii) I gave the participants the purpose and the domain of the study.

(iii) I explained to the participants that there would be no harm, physically or emotionally incurred by participating in the study. I explained that no sensitive issues would be discussed in the study.

(iv) I did not invade the privacy of the participants. No questions probing their personal affairs were asked during interviews.

(v) I protected the anonymity and confidentiality of the participants by not using their real names in the report.

(vi) I respected the autonomy of participants in the study. I explained to them that they could withdraw from the study at anytime if they so wished or if they did not feel comfortable in the study.

I hoped that by adhering to these principles the ethical considerations of participants would be safeguarded and that their ethical dilemmas would be allayed.

3.7 Reliability and Validity

Reliability refers to the consistency and replicability over time, over instruments and over groups of respondents (Cohen *et al*, 2000). It refers to the likehood that a given measurement procedure will give the same description of a particular phenomenon if the measurement is used again (Babbie *et al*, 2007). If the method used in the research yields the same results over and over again we can say that it is reliable. To make sure that reliability was secured in my study I asked the participants only the things that they knew and which were relevant to them and the study.

To ensure reliability in my study I clearly conceptualized constructs, used a precise level of measurement, used multiple indicators and piloted the data collection instrument (Neuman, 2006). I made sure that the constructs in my questionnaire measure one thing at

a time. If a single construct is be used to measure two or more things in the study this can create ambiguity and uncertainty in the respondents. If a same construct measures two or more things in the study there will be disruption and interference of information in the study and this could render the study to be unreliable. To ensure the preciseness in the level of measurement I arranged my Likert scale such that it is neither too high nor too low. Also, each level was clearly defined what it means. For an example in Section 5 of the questionnaire (support measurement), 1→Very Poor, 2→Poor, 3→Good, 4→Very Good and 5→Excellent. These levels are clearly defined so that there could be no confusion. Another way of increasing reliability in my study was to use multiple indicators, i.e. the use of more than one indicator to measure the same construct. For an example, Section 7 and Section 8 in the questionnaire are measuring one construct in different ways. They are both measuring the influence of CTAs in teachers. The last strategy I used to ensure reliability was to pilot my study. I gave my questionnaire to 4 friends of mine to complete it and critique it. After piloting the questionnaire some minor problems were identified and I had to make some changes on it.

Validity on the other hand refers to the extent to which empirical measures adequately reflect the real meaning of the phenomenon under speculation (Babbie *et al*, 2007). It refers to the extent to which the data collection method accurately measures what it is intended to measure. It deals with genuineness and trustworthiness of research methodology. It also deals with confidence in conclusion and generalizability of the findings to the whole population. To secure validity in my study I decided to use triangulation.

Triangulation refers to the use of two or more data collection methods in a research (Cohen *et al*, 2000). In my study I used both quantitative and qualitative methods. Such triangulation is referred to as methodological triangulation or triangulation between the methods (Cohen *et al*, 2000). The use of two methods can help to indicate data collection error. If the analysis of quantitative data correlates with that of qualitative data then I could say that the results were valid. Triangulation also ensured that the multiplicity of

perspectives present in a social situation may be discerned. Hence the richness of the situation being researched would be enhanced.

3.8 Challenges and Limitations Related to Data Collection

Initially I had a problem with data collection. The questionnaires that were sent to respondents were not returned timeously. I set myself a period of three to six weeks to receive the returned questionnaires. To my greatest surprise very little questionnaires were returned in time. I had to write several letters to remind the respondents to return the questionnaires but some still did not return the questionnaire. After reminding the respondents several times to return the questionnaires, still very few were returned. It was discouraging when I considered that I sent out about 80 questionnaires. Eventually my sample for the study was reduced to 32. Although 32 is a very low number but Cohen *et al* (2000) said a sample of 30 respondents can be used to probe an educational phenomenon. This non-response behaviour of the respondents disturbed me a lot because I had to reschedule my research programme and limit my sample. This implied that I could not finish the study on the due course.

The same problem occurred when I had to carry out the schedule of interviews. People were reluctant to participate in the interviews. They thought that this is a catch-up strategy by the department of education to check on how they deal with CTAs. It was even worse when they heard that the interviews would be recorded on the tape. Such incidents were disappointing but eventually 5 teachers agreed to be interviewed.

I had to come with the strategy to overcome the limitations posed by non-response of respondents with questionnaire. To overcome this limitation I decided to use self administrative questionnaires. I decided to visit Natural Science workshops where I could speak personally with the teachers and give them questionnaire myself. I hoped this would be more effective because I would have spoken face to face with respondents. I did this so as to clarify if there were still lacking problems with questionnaires I had to. Even after administering questionnaires to teachers in workshops, the response was still not

good. It means after the teachers had gone away from workshops they just conveniently forgot about my questionnaires. As a last resort I decided to administer the questionnaires myself to the neighbouring schools so as to get a sample size of at least 30 respondents. Finally I managed to get a sample of 32 respondents and then I began my analysis.

3.9 Conclusion

In this chapter I presented my plan (research methodology) that I followed in my study. I explained my methodological approach, research structure, data collection method, sampling procedure, research instrument design, data analysis method, ethical considerations, validity and reliability strategies, challenges and limitations related to data collection, and conclusion about what I have achieved.

The research sought to portray the views of teachers on the influence of CTAs on the pedagogical practices of Grade 9 Natural Science teachers. The research methodology was therefore structured such that the views of the teachers can be captured. The questionnaire was structured in such a way that the factors that could possibly affect the influence of CTAs could be investigated. Interviews were used to verify the findings of questionnaires. What follows hereinafter is the data representation and analysis which will show how CTAs influence Grade 9 Natural Science teachers' practices.

CHAPTER 4

DATA ANALYSIS

Both quantitative and qualitative analyses were done in the study. Quantitative techniques were used to analyze questionnaires and qualitative techniques were used to analyze interviews. Both these strategies sought to investigate the influence of CTAs on the pedagogical practices of Grade 9 Natural Science teachers. The practices in this case being the strategies the teachers use in their classes and the work they give to the learners. The analysis of data responses from quantitative and qualitative study with a view to answering the research questions is given below:

4.1 Quantitative Analysis

Out of more than 80 questionnaires that were sent to teachers, 32 eventually came back. The data from each of the 32 questionnaires were entered into the Coded Data Table. The first column of the Coded Data Table gives the case number of each analysed questionnaire. Columns 2 to column 11 deal with the quantifiable data. Column 11 contains the opinions of teachers about the categories of work which are influenced by CTAs. Teachers were asked to select, among 10, the categories of work which they think are influenced by CTAs. The number of categories which teachers select was entered into the Coded Data Table for each case. This number then indicated the extent to which, according to that particular teacher, CTAs influence teachers' practice. Other columns are looked at in relation to column 11. I determined if there is a correlation between other columns (intervening factors) and column 11 (CTAs influence). If it was found that there is a positive correlation between the particular factor and CTAs influence that would mean that the particular intervening factor affects the influence of CTAs on teachers. Column 10 is closely related to column 11. In fact column 10 is used to validate or cross check the trustworthiness of the data in column 11. Other columns (i.e. columns 2 to 9) look into other factors that could affect the influence of CTAs on teachers. The Coded

Data Table with raw data is given below and the coding system for interpreting the data is given on page 60 and 61:

1	2	3	4	5	6	7	8	9	10	11
Case	Gender	Teaching Experience (in years)	Inservice Trainings Attended	Area Type	Class Size	Resources availability	Support given to teachers	Leaners' Character (behaviour)	Strategy Mostly Used	Influence Of CTAs On Work
1	1	7	2	1	3	2	10	30	23	6
2	2	10	2	2	2	2	21	56	29	6
3	2	3	1	3	2	2	13	42	34	5
4	2	15	3	2	3	1	6	53	16	8
5	2	5	2	2	3	1	16	59	31	6
6	2	10	1	1	3	1	9	29	33	0
7	2	16	3	2	2	2	10	51	30	7
8	1	6	0	3	1	1	16	75	39	6
9	1	3	2	1	2	1	11	22	17	0
10	2	12	5	2	2	1	12	49	36	2
11	1	4	0	1	3	1	20	28	31	7
12	1	23	3	2	2	3	15	53	31	8
13	2	11	2	2	3	2	25	57	33	5
14	2	14	2	1	3	2	22	39	25	7
15	1	21	1	2	2	2	13	33	33	8
16	2	10	2	1	3	1	9	36	33	10
17	1	7	3	2	2	1	17	52	29	6
18	1	9	3	2	2	2	22	57	34	10
19	1	7	0	2	3	2	17	61	29	0
20	1	14	3	1	3	1	11	34	25	8
21	1	2	0	1	3	1	7	21	16	1
22	1	19	5	3	2	3	22	60	30	10
23	2	12	2	3	2	2	21	64	28	9
24	2	12	2	1	3	1	9	21	13	0
25	2	17	3	3	1	3	25	73	34	10
26	2	12	2	3	1	3	27	75	36	10
27	1	14	5	2	2	2	20	70	29	7
28	1	5	1	1	3	1	11	32	17	2
29	2	10	2	1	3	1	7	25	19	2
30	2	11	3	1	2	2	17	49	27	7
31	2	13	2	1	3	1	7	18	14	0
32	1	19	3	1	3	2	8	20	16	1
S		**353**	**70**				**476**	**1444**	**870**	**174**

Table 4.1 Coded Data Table As Per Questionnaire Response

The averages calculated from the coded data table follow below:

Experience = 353 ÷ 32 = **11,03**

Inservice Training = 70 ÷ 32 = **2,19**

Support = 476 ÷ 32 = **14,88**

Learners' Character = 1444 ÷ 32 = **45,13**

Strategy Mostly Used = 870 ÷ 32 = **27,19**

Influence Of CTAs on Work = 174 ÷ 32 = **5,44**

These averages helped me in my data analysis. For an example I could deduce that the average teaching experience of the respondents was 11 years. Also I could deduce that most respondents have at least attended two inservice trainings. Please note that the support is out of thirty, learners' character out of seventy five, strategy mostly used out of fifty and CTAs influence on work out of ten. After manipulating these averages I could deduce that the teachers are getting almost 50% of the support they are expecting to get (14,88 over 30 is almost 50%). Learners' Character yields 60%, (45,13 over 75 is almost 60%). From this I can conclude that at an average the learners' behaviour is good. I also deduced that CTAs influence about 54% of teachers' practices or strategies (5,44 over 10 is almost 54%). The analyses of each of the factors follow hereinafter:

4.1.1 Gender

Out of 32 respondents that brought back the questionnaires, 15 of them (47%) were males and 17 of them (53%) were females. Twenty seven of them (84%) indicated that their practices are influenced by CTAs. They chose **YES** in some of categories of work perceived to be influenced by CTAs (section 8 of the questionnaire,) and this data is entered in column 11 in the coded data tabled, i.e. influence column. Five of them (16%) indicated that their practices are not influenced by CTAs, they chose straight **NO**s on influence section (section 8) of the questionnaires. Out of 27 who said they are influenced, 13 of them (40%) are males and 14 of them (44%) are females. Out of 5 who

said they are not influenced, 2 of them (7%) are males and 3 of them (9%) are females. The bar graph representing this data is given below:

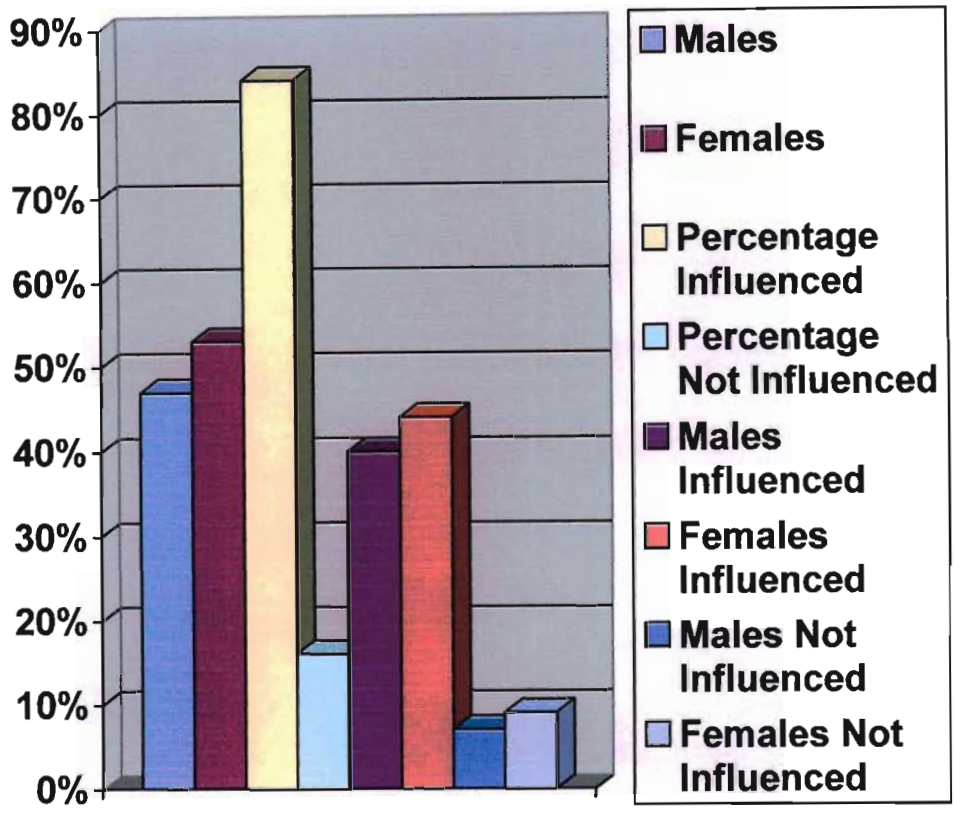

Figure 4.1 Gender-Information Bar Graph

4.1.2 Experience

The teaching experience of the respondents ranges between 2 and 23 years and their average teaching experience is 11 years. From this I could deduce that the majority, though not all, of the teachers teaching Grade 9 Natural Science are well experienced and therefore they should be able to handle the new curriculum. To determine if the teaching experience has any correlation with the influence of CTAs on teachers' practices,

Pearson's correlation coefficient **r** was calculated (Goddard and Melville, 2001 and Curwin and Slater, 2007). The full calculation is given below:

Case No.	X	Y	XY	X^2	Y^2
1	7	6	42	49	36
2	10	6	60	100	36
3	3	5	15	9	25
4	15	8	120	225	64
5	5	6	30	25	36
6	10	0	0	100	0
7	16	7	112	256	49
8	6	6	36	36	36
9	3	0	0	9	0
10	12	2	24	144	4
11	4	7	28	16	49
12	23	8	184	529	64
13	11	5	55	121	25
14	14	7	98	196	49
15	21	8	168	441	64
16	10	10	100	100	100
17	7	6	42	49	36
18	9	10	90	81	100
19	7	0	0	49	0
20	14	8	112	196	64
21	2	1	2	4	1
22	19	10	190	361	100
23	12	9	108	144	81
24	12	0	0	144	0
25	17	10	170	289	100
26	12	10	120	144	100
27	14	7	98	196	49
28	5	2	10	25	4
29	10	2	20	100	4
30	11	7	77	121	49
31	13	0	0	169	0
32	19	1	19	361	1
Total (∑)	**353**	**174**	**2130**	**4789**	**1326**

Table 4.2 Correlation Table: Experience (X) vs CTAs Influence (Y)

From the Table above; $Sx = 353$, $Sy = 174$, $Sxy = 2130$,

$Sx^2 = 4789$, $Sy^2 = 1326$

$$r = \frac{n\sum xy - \sum x . \sum y}{\sqrt{n\sum x^2 - (\sum x)^2} \times \sqrt{n\sum y^2 - (\sum y)^2}}$$

$$= \frac{32(2130) - 353 \times 174}{\sqrt{32 \times 4789 - (353)^2} \times \sqrt{32 \times 1326 - (174)^2}}$$

$$= 0{,}361$$

There is a weak positive correlation between experience and CTAs influence. Correlation coefficient measures the strength of the relationship between the variables. It lies between -1 and +1. If the coefficient is positive it means that as one quantity goes up the other also goes up (positive correlation) and if the coefficient is negative it means that as one quantity goes up the other quantity goes down (negative correlation). If the coefficient is zero it means that there is no relationship between the quantities. The coefficient between -1 and -0,5 means that there is a strong negative correlation between variables and the coefficient between -0,5 and 0 means that there is a weak negative correlation between variables. The coefficient between 0 and +0,5 means that there is a weak positive correlation between variables and the coefficient between +0,5 and +1 means that there is a strong positive correlation between variables. Since the coefficient in our case is 0,361, it means it lies between 0 and +0,5, so there is a weak positive correlation between teaching experience and CTAs influence. This means that as the teaching experience increases the tendency of teachers of being influenced by CTAs also increases, though to a very low extent because the correlation is weak.

4.1.3 Inservice Training

Out of 32 respondents, 28 of them (i.e. 88%) had undergone inservice training and 4 of them (i.e. 12%) had never had any inservice training. They indicated that some of the workshops they attended were RNCS workshops. From this I could conclude that the large majority of teachers (i.e. 88%) have been workshoped about the new curriculum, so

they should be able to cope with CTAs. From the data, the average inservice training sessions that the teachers had were 2 sessions. Pearson's correlation coefficient (**r**) was also determined for inservice training and the complete calculation is given in table 4.3 below:

Case No.	X	Y	XY	X^2	Y^2
1	2	6	12	4	36
2	2	6	12	4	36
3	1	5	5	1	25
4	3	8	24	9	64
5	2	6	12	4	36
6	1	0	0	1	0
7	3	7	21	9	49
8	0	6	0	0	36
9	2	0	0	4	0
10	5	2	10	25	4
11	0	7	0	0	49
12	3	8	24	9	64
13	2	5	10	4	25
14	2	7	14	4	49
15	1	8	8	1	64
16	2	10	20	4	100
17	3	6	18	9	36
18	3	10	30	9	100
19	0	0	0	0	0
20	3	8	24	9	64
21	0	1	0	0	1
22	5	10	50	25	100
23	2	9	18	4	81
24	2	0	0	4	0
25	3	10	30	9	100
26	2	10	20	4	100
27	5	7	35	25	49
28	1	2	2	1	4
29	2	2	4	4	4
30	3	7	21	9	49
31	2	0	0	4	0
32	3	1	3	9	1
Total (∑)	**70**	**174**	**427**	**208**	**1326**

Table 4.3 Correlation Table: Inservice Training (X) vs CTAs Influence (Y

From the table above; $\sum x = 70$, $\sum y = 174$, $\sum xy = 427$,
$\sum x^2 = 208$, $\sum y^2 = 1326$

$$r = \frac{n\sum xy - \sum x . \sum y}{\sqrt{n\sum x^2 - (\sum x)^2} \times \sqrt{n\sum y^2 - (\sum y)^2}}$$

$$= \frac{32 \times 427 - 70 \times 174}{\sqrt{32 \times 208 - (70)^2} \times \sqrt{32 \times 1326 - (174)^2}}$$

$$= 0{,}321$$

Since 0,321 lies between 0 and +0,5, it means that there is a weak positive correlation between inservice training and CTAs influence. This means that as the number of inservice trainings increase teachers tend to be more influenced by CTAs but to a very low extent because the correlation is weak.

4.1.4 School Profile

The school profile in this case refers to the factors or circumstances surrounding or existing in a school and which affect the teaching and learning in the school. There are many factors that can affect teaching and learning in the school but for the purpose of investigating CTAs influence on teachers' practices I limited myself to three categories i.e., catchment area, class size and resources availability. With respect to catchment area schools are divided into rural schools, township schools and urban schools. With respect to class size I classified classes into big classes, medium size classes and small classes. With respect to resource availability I classified schools into well resourced schools, marginally resourced schools and poorly resourced schools. The analysis of the data for these categories of schools' profiles is given below.

4.1.4.1 Catchment Area

In the sample, 14 teachers (44%) teach in rural schools, 12 of them (37%) teach in township schools and 6 of them (19%) teach in urban school. The following bar graph and pie chart show the distribution of schools according to catchment area:

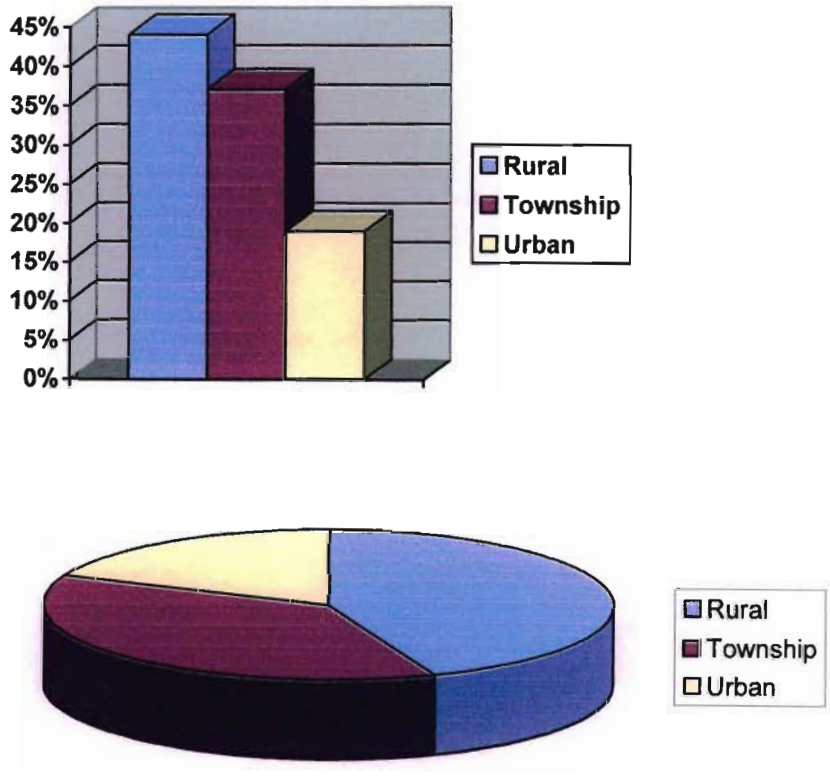

Figure 4.2 Catchment Area Bar and Pie Graphs

The averages, out of 10, of CTAs influence on teachers' practices according to catchment area are as follows:

Rural = 4, Township= 6, Urban= 8

As these are measured out of 10, so CTAs have 40% influence on the work of teachers in rural schools, 60% on teachers in township schools and 80% on teachers in urban schools. The bar graph representing this data is given below:

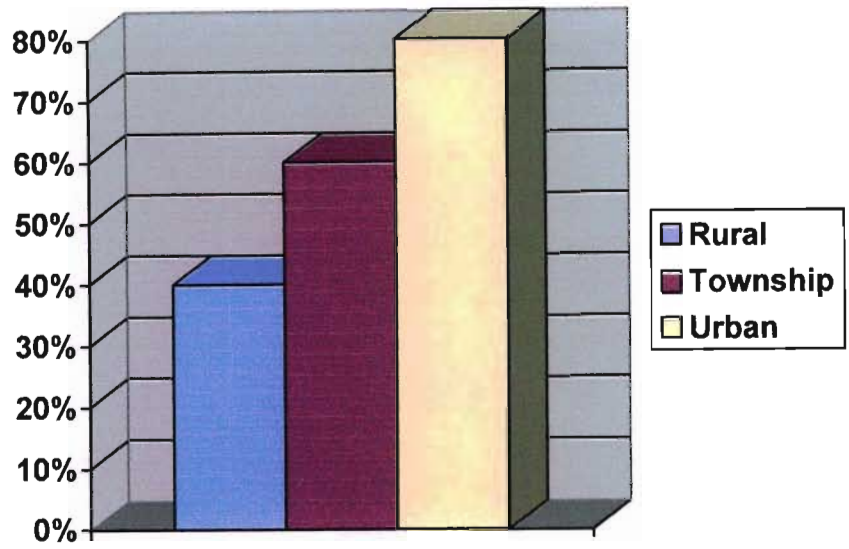

Figure 4.3 CTAs Influence According To Catchment Area

From this we can see that teachers in urban school are influenced the most by CTAs and teachers in the rural areas are influenced the least.

4.1.4.2 Class Sizes

In the sample,16 teachers (50%) teach in big classes. Big classes are those classes with learners more than 50 in a class. Thirteen teachers (41%) teach in medium size classes, i.e. classes with learners between 30 and 50, and 3 teachers (9%) teach in small classes, i.e. classes with learners less than 30. The bar graph and pie chart for this data are given below:

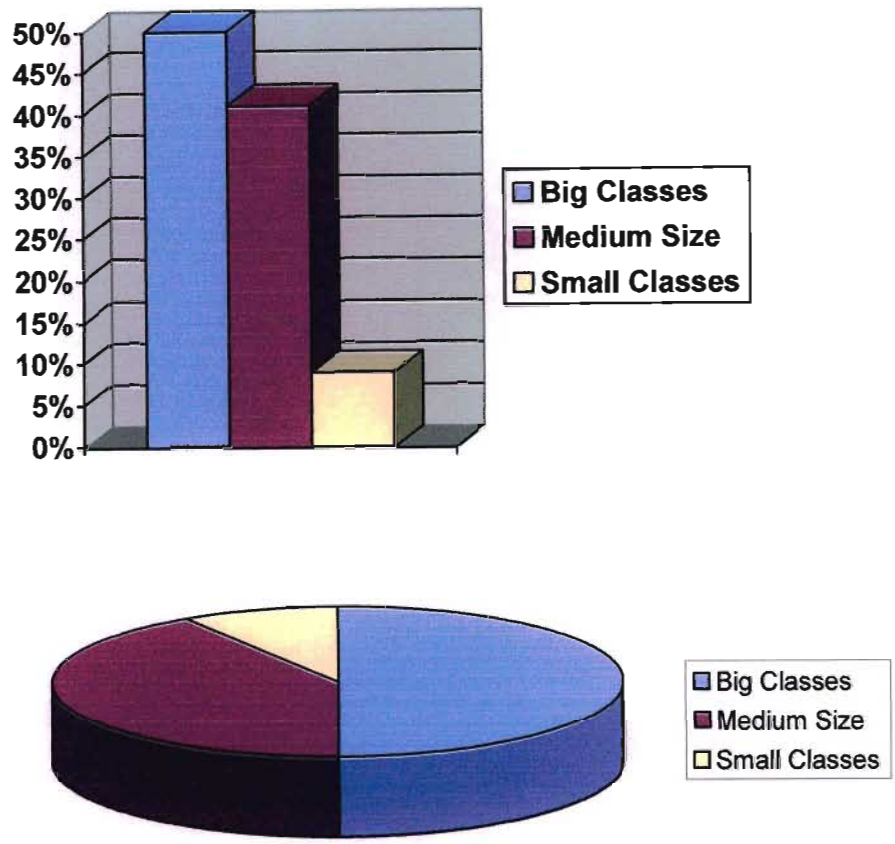

Figure 4.4 Class Size Bar and Pie Graphs

The averages out of ten, of CTAs influence on teachers work according to class sizes are as follows:

Big Classes = 4, Medium size Classes = 7, Small Classes = 9

We can deduce that CTAs influence 40% of teachers' work in big classes, 70% of teachers' work in medium size classes and 90% of teachers' work in small classes. The bar graph for this data is given below:

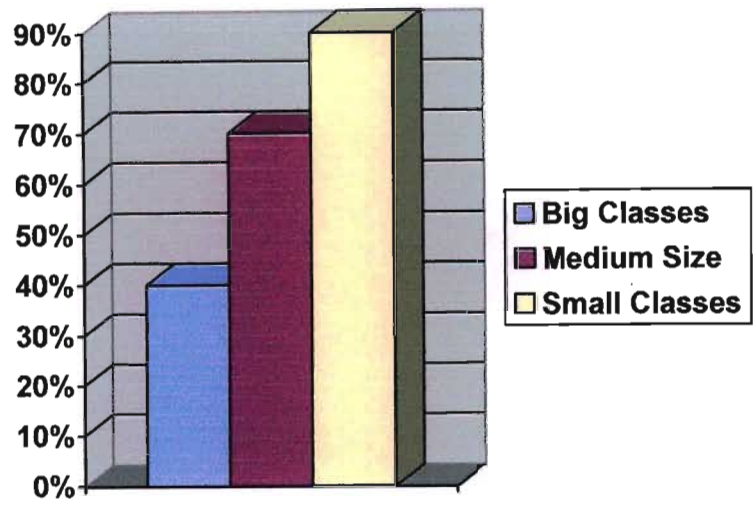

Figure 4.5 CTAs Influence According To Class Size

The data show that teachers who teach small classes are influenced the most by CTAs and teachers who teach big classes are influenced the least.

4.1.4.3 Resources

The availability of resources affects teaching and learning in schools. Resources in this case refer to those things that support or sustain teaching and learning at school. They can be classified into human, financial, physical and material. The resources that affect teaching and learning immediately are physical and material resources, though they themselves are affected by the availability of financial resources. In most cases human resources remain being departmental responsibility in public schools. The resources investigated here refers to those that are in most cases handled by schools directly, i.e., physical, financial and material resources.

In the sample, 15 teachers (47%) teach in poorly resourced schools, 13 of them (41%) teach in marginally resourced schools and 4 of them (12%) teach in well resourced schools. The bar graph and pie chart of this data are given below:

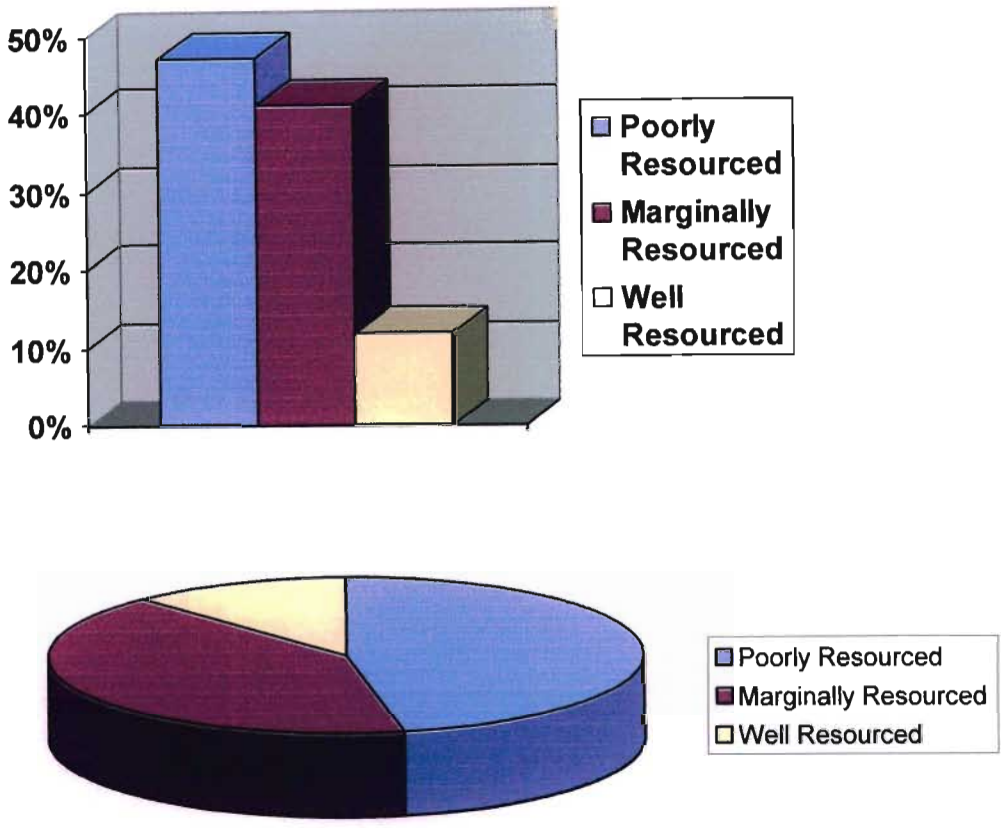

Figure 4.6 Resources Bar and Pie Graphs

The averages of CTA influence on teachers work according to resource availability are as follows:

Poorly resourced schools = 4 Marginally resourced schools = 6

Well resourced schools = 9

Since these are calculated out of ten, this means that CTAs influence 40% of teachers' work of teachers teaching in poorly resourced schools, 60% of work of teachers teaching in marginally resourced schools and 90% of teachers teaching in the well resourced schools. The bar graph for this information is given below:

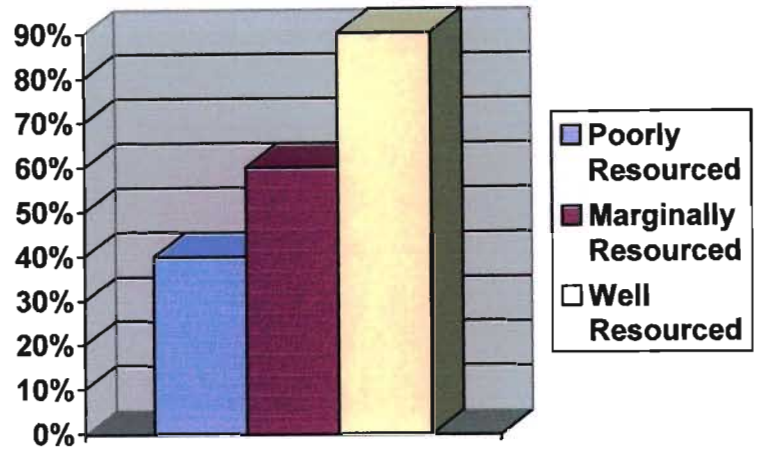

Figure 4.7 CTAs Influence According To Resources

The data show that teachers teaching in well resourced schools are influenced the most by CTAs and those teaching in poorly resourced schools are influenced the least.

4.1.5 Support

The influence of CTAs on teachers is also linked to the support they get in their schools. Teachers were asked to rank the support they receive in their schools. Support is a construct and the Likert scale was used to opperationalise it. The Likert scale was used to enable the teachers to rank the support the support they get in their schools. Using this scale, support was differentiated into five classes, i.e. very poor (1), poor (2), good (3), very good (4) and excellent (5). This is found in section 5 of the questionnaire and column 8 of Coded Data Table. Teachers had to rank the support given to them by their HODs, Deputy Principals, Principals, Subject Advisors, SEMs and SGBs. Since the highest rate of the Likert scale (i.e. excellent) in this section is 5, the highest score that could be attained here is 30, (6 x 5 = 30).

The average of the support was calculated, and it was found to be 15, and this corresponds to 50%. From this we can deduce that the teachers get 50% of the support

they are expecting to get in their schools. If this divided by 6, (the number of items in the section) we get 2,5 and rounded of to 3. This corresponds to **Good** on the Linkert scale of support. This means that at an average, teachers get good support in their schools. Pearson's correlation coefficient (**r**) was also calculated to check if there is any correlation between support and CTAs influence, the results are given in table 4.4 below:

Case No.	X	Y	XY	X^2	Y^2
1	10	6	60	100	36
2	21	6	126	441	36
3	13	5	65	169	25
4	6	8	48	36	64
5	16	6	96	256	36
6	9	0	0	81	0
7	10	7	70	100	49
8	16	6	96	256	36
9	11	0	0	121	0
10	12	2	24	144	4
11	20	7	140	400	49
12	15	8	120	225	64
13	25	5	125	625	25
14	22	7	154	484	49
15	13	8	104	169	64
16	9	10	90	81	100
17	17	6	102	289	36
18	22	10	220	484	100
19	17	0	0	289	0
20	11	8	88	121	64
21	7	1	7	49	1
22	22	10	220	484	100
23	21	9	189	441	81
24	9	0	0	81	0
25	25	10	250	625	100
26	27	10	270	729	100
27	20	7	140	400	49
28	11	2	22	121	4
29	7	2	14	49	4
30	17	7	119	289	49
31	7	0	0	49	0
32	8	1	8	64	1
Total (∑)	**476**	**174**	**2967**	**8252**	**1326**

Table 4.4 Correlation Table: Support (X) vs CTAs Influence (Y)

From the table above; $\sum x = 476$ $\sum y = 174$ $\sum xy = 2967$

$\sum x^2 = 8252$ $\sum y^2 = 1326$

$$r = \frac{n\sum xy - \sum x . \sum y}{\sqrt{n\sum x^2 - (\sum x)^2} \times \sqrt{n\sum y^2 - (\sum y)^2}}$$

$$= \frac{32 \times 2967 - (476 \times 174)}{\sqrt{32 \times 8252 - (476)^2} \times \sqrt{32 \times 1326 - (174)^2}}$$

$$= 0{,}568$$

There is a strong positive correlation between support and CTAs influence on teachers. This means that as the support given to teachers gets better and better teachers tend to be more influenced by CTAs.

4.1.6 Learners' Character

Learners' character in this case refers to the behaviour of learners. I had a hunch that learners' behaviour affects teachers' practices. I classified learners' character (behaviour) into very poor, poor, good, very good and excellent. In the questionnaire very poor is denoted by never, poor is denoted by seldom, good is denoted by sometimes, very good is denoted by often and excellent is denoted by always. Likert scale was used to rank the learners' character (section 6 of the questionnaire).

Teachers were asked to rank the character of their students. The average of learners' character was calculated to be 45. There are 15 items in this category and if we divide by 15 we get 3 which corresponds to often or good behaviour. This means that the average behavior of learners, according to my measuring scale is good. As a percentage, the results showed that learners are more or less 60% behaved (45 ÷ 75 x 100 = 60). Learners' character is out of 75 and 45 out of 75 give 60%.

To analyze the data further Pearson's correlation coefficient (**r**) was calculated and the results are given in table 4.5 below:

Case No.	X	Y	XY	X^2	Y^2
1	30	6	180	900	36
2	56	6	336	3136	36
3	42	5	210	1764	25
4	53	8	424	2809	64
5	59	6	354	3481	36
6	29	0	0	841	0
7	51	7	357	2601	49
8	75	6	450	5625	36
9	22	0	0	484	0
10	49	2	98	2401	4
11	28	7	196	784	49
12	53	8	424	2809	64
13	57	5	285	3249	25
14	39	7	273	1521	49
15	33	8	264	1089	64
16	36	10	360	1296	100
17	52	6	312	2704	36
18	57	10	570	3249	100
19	61	0	0	3721	0
20	34	8	272	1156	64
21	21	1	21	441	1
22	60	10	600	3600	100
23	64	9	576	4096	81
24	21	0	0	441	0
25	73	10	730	5329	100
26	75	10	750	5625	100
27	70	7	490	4900	49
28	32	2	64	1024	4
29	25	2	50	625	4
30	49	7	343	2401	49
31	18	0	0	324	0
32	20	1	20	400	1
Total (∑)	**1444**	**174**	**9009**	**74826**	**1326**

Table 4.5 Correlation Table: Learners' Character (X) vs CTAs Influence (Y)

From the table above; $\sum x = 1444$, $\sum y = 174$, $\sum xy = 9009$

$\sum x2 = 74826$, $\sum y2 = 1326$

$$r = \frac{n\sum xy - \sum x . \sum y}{\sqrt{n\sum x^2 - (\sum x)^2} \text{ x } \sqrt{n\sum y^2 - (\sum y)^2}}$$

$$= \frac{32 \text{ x } 9009 - 1444 \text{ x } 174}{\sqrt{32 \text{ x } 74826 - (1444)^2} \text{ x } \sqrt{32 \text{ x } 1326 - (174)^2}}$$

$$= 0{,}604$$

There is a strong positive correlation between learners' character and CTAs' influence. This means that teachers with well-behaved learners are more influenced by CTAs.

4.1.7 Learners' Work

Learners' work appears on section seven of the questionnair. Ten categories of learners' work were given and the teachers had to indicate how often do they engage a particular category? This helped to indicate the strategies that the teachers use the most. Tallies and calculations from the frequencies were done and are given in the table below.

How often do you give the following work to learners	**Never**	**Seldom**	**Sometimes**	**Often**	**Always**	**Total** 160	**%**
Group work		II	IIIII IIIII IIIII	IIIII IIIII III	II	111	69
	1x0=0	2x2=4	3x15=45	4x13=52	5x2=10		
Problem solving (Mathematical or theoretical	II	IIIII	IIIII IIIII I	IIIII IIIII I	III	104	65
	1x2=2	2x5=10	3x11=33	4x11=44	5x3=15		
Practical work (Exercises)	IIIII	IIIII II	IIIII IIIII IIII	IIIII I	5x0=0	85	53
	1x5=5	2x7=14	3x14=42	4x6=24			
Investigations (Inquiry)	IIIII III	IIIII	IIIII IIIII IIIII	IIII	5x0=0	79	49
	1x8=8	2x5=10	3x15=45	4x4=16			
Projects	IIIII II	IIIII III	IIIII IIIII IIIII	II	5x0=0	76	48
	1x7=7	2x8=16	3x15=45	4x2=8			
Field work	IIIII IIIII I	IIIII IIII	IIIII IIIII	II	5x0=0	67	42
	1x11=11	2x9=18	3x10=30	4x2=8			
Report Writing	IIIII I	IIIII IIIII I	IIIII II	IIIII III	5x0=0	81	51
	1x6=6	2x11=22	3x7=21	4x8=32			
Pupils presentation	II	IIIII	IIIII IIIII IIIII II	IIIII III	5x0=0	95	59
	1x2=2	2x5=10	3x17=51	4x8=32			
Self assessment	IIIII	IIIII	IIIII IIIII IIII	IIIII III	5x0=0	89	56
	1x5=5	2x5=10	3x14=42	4x8=32			
Peer Assessment	IIIII III	IIIII II	IIIII IIIII II	IIIII	5x0=0	78	49
	1x8=8	2x7=14	3x12=36	4x5=20			

Table 4.6 Frequency of Giving Work

The following bar-graph represents the above data:

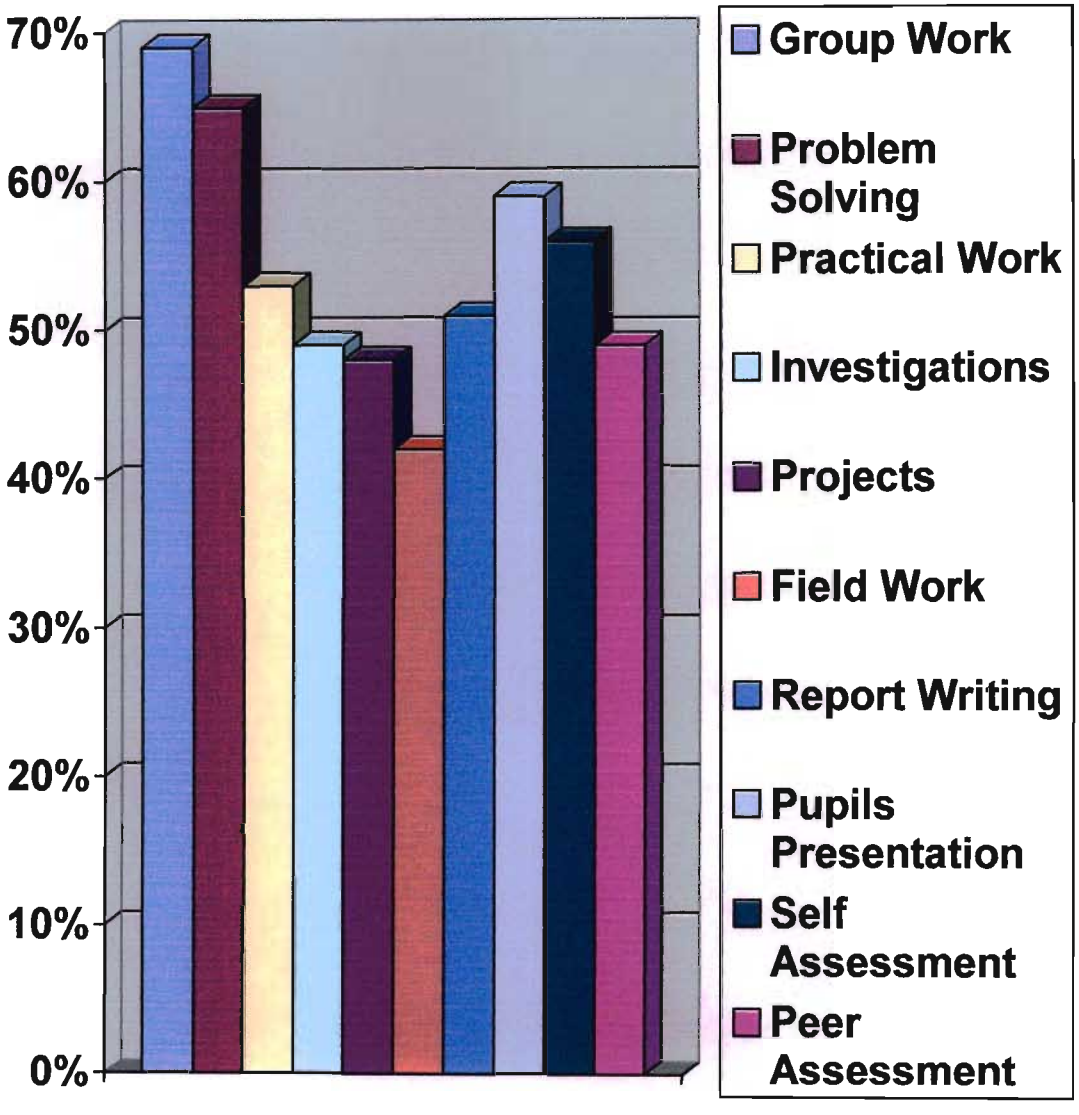

Figure 4.8 Work Frequency Bar Graph

From these results it seems as if group work is used the most and field work the least. In a descending order, the strategies are as follows:

1. Group work 69%, **2**. Problem solving 65%, **3**. Pupils presentation 59%,

4. Self assessment 56%, **5**. Practical work 53%, **6**. Report writing 51%

7. Investigation 49% **8**. Peer assessment 49% **9**. Project 48% 10

10. Field work 42%

To analyze the data for the measure of central tendency and dispersion was done. The following quantities were calculated: mean, mode, median, standard deviation, and the skewness of data. The frequency distribution table for the data is given below:

Classes	f	x	xf	F	$x-\bar{x}$	$\left(x-\bar{x}\right)^2$	$\left(x-\bar{x}\right)^2 f$
13 -< 18	7	15,5	108,5	7	-12,5	156,25	1093,75
18 -< 23	1	20,5	20,5	8	-7,5	56,25	56,25
23 -< 28	4	25,5	102	12	-2,5	6,25	25,00
28 -< 33	10	30,5	305	22	-2,5	6,25	62,50
33 -< 38	9	35,5	319,5	31	- 7,5	56,25	506,25
38 -< 43	1	40,5	40,5	32	-12,5	156,25	156,25
Total (∑)	**32**		**896**				**1900,00**

Table 4.7 Statistics Frequency Distribution Table

Statistics calculations are given below:

Mean $(\bar{x})$

$$\bar{x} = \frac{\sum xf}{n} = \frac{896}{32} = 28$$

Mode (M_o)

$$M_o = l + \frac{(f_m - f_{m-1})}{(2f_m - f_{m-1} - f_{m+1})} \text{ x } i$$

$$= 28 + \frac{(10-4)}{(2 \text{ x } 10 - 4 - 9)} \text{ x } 5 = 32$$

Median (M_e)

$$M_e(pos) = \frac{n}{2} = \frac{32}{2} = 16$$

F above 16 is 22, therefore Me is in interval 28 -< 33 and the F below 16 is 12

$$M_e = l + \frac{i\left(\frac{n}{2} - F\right)}{f}$$

$$= 28 + \frac{5(16-12)}{10} = 30$$

The mean, mode and median are very close to each other. This means that the data is reliable. The calculations show that the mode is greater than the median and the median is greater than mean. This means that the data is negatively skewed, and this is confirmed in the calculation below:

Skewness (Sk)

$$Sk = \frac{3\left(\bar{x} - M_e\right)}{S} = \frac{3(28-30)}{7{,}8} = -0{,}77$$

There is strong negative skewness in the data. This means that there is a quite a number of relatively small values in the data set.

Standard Deviation

$$S = \sqrt{\frac{\sum\left(x - \bar{x}\right)^2 f}{n-1}} = \sqrt{\frac{1900}{31}} = 7{,}8$$

The standard deviation is low. This means that there is low variability in the data. If there is low variability in the date it means that the findings of the data can be trusted.

4.1.8 Influence of CTAs on Work

Teachers were asked to state their opinions on whether CTAs have any influence on the work they give to learners. This helped me to determine whether CTAs do have influence on pedagogical practice of the teachers. Ten categories of work that are associated with CTAs were given and the teachers had to indicate if these categories of work are influenced by CTAs in their teaching practices. These include group work, problem solving, practical work, investigations, projects, field work, report writing, pupils' presentation, self assessment and peer assessment. If all the teachers had selected **NO** in all categories, that would mean that CTAs do not influence teachers' practices at all. A **YES** selection in a particular category would mean that the particular work is influenced by CTAs, and therefore that would mean that some teachers are influenced by CTAs.

Out of 32 respondents, 27 of them (84%) indicated that some of the work they give to learners is influenced by CTAs. They chose **YES** option in some categories. Five of them (16%) indicated that they are not influenced by CTAs, they chose **NO** in all categories. The average calculated for CTAs influence on teachers was 5,44 out of 10. This meant that CTAs influence about 54,4% of teachers' work. The analysis (tallies and percentages) of each category is given in the table below:

Given Work	Yes		No	
Group work	𝍸 𝍸 𝍸 𝍸 𝍸		𝍸 𝍸	
	25	(78%)	7	(22%)
Problem solving (Mathematical or theatrical)	𝍸 𝍸 𝍸 𝍸 𝍸		𝍸 𝍸	
	23	(72%)	9	(25%)
Practical work (Exercises)	𝍸 𝍸 𝍸 𝍸		𝍸 𝍸 𝍸	
	18	(56%)	14	(44%)
Investigations (Inquiry)	𝍸 𝍸 𝍸 𝍸		𝍸 𝍸 𝍸	
	17	(53%)	15	(47%)
Projects	𝍸 𝍸 𝍸		𝍸 𝍸 𝍸 𝍸	
	14	(44%)	18	(56%)
Field work	𝍸 𝍸 𝍸		𝍸 𝍸 𝍸 𝍸	
	13	(41%)	19	(59%)
Report Writing	𝍸 𝍸 𝍸 𝍸		𝍸 𝍸 𝍸	
	19	(59%)	13	(41%)
Pupils presentation	𝍸 𝍸 𝍸 𝍸		𝍸 𝍸 𝍸	
	18	(56%)	14	(44%)
Self assessment	𝍸 𝍸 𝍸		𝍸 𝍸 𝍸 𝍸	
	15	(47%)	17	(53%)
Peer Assessment	𝍸 𝍸 𝍸		𝍸 𝍸 𝍸 𝍸	
	14	(44%)	18	(56%)

Table 4.8 Influence of CTAs on Work

From the analysis of the data, it can be seen that group work is influenced the most and field work the least. The same pattern was observed with the data associated with the work the teachers give to leaners. In a descending order, the CTAs influence is as follows:

1. Group Work 78%, **2**. Problem Solving 72%, **3**. Report Writing 59%,
4. Practical Work 56%, **4**. Pupils Presentation 56%, **6**. Investigations 53%,
7. Self Assessment 47%, **8**. Peer Assessment 44%, **8**. Projects 44%
10. Field Work 41%.

The bar-graph representing the above data is given below:

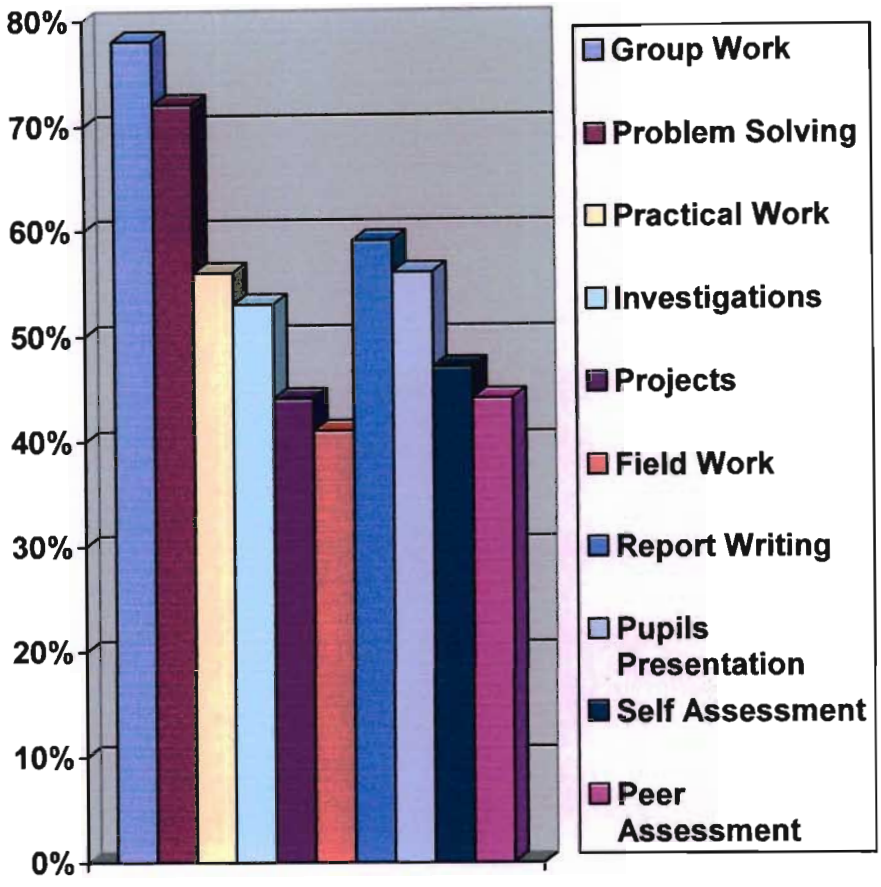

Figure 4.9 Overall CTAs Influence Bar Graph

The quantitative analysis shone a necessary light to illuminate the phenomenon, i.e., the influence of CTAs on pedagogical practices of Grade 9 science teachers. It has shown that about 84% of teachers are influenced by CTAs. It has also shown which practices are influenced by CTAs, e.g., it has shown that group work, problem solving, report writing, practical work, pupils presentation are influenced the most by CTAs. What remained then was to verify whether these results were true. To do so qualitative analysis of interviews was carried out and the results follow hereinafter.

4.2 Qualitative Analysis

Interviews were carried out to probe the phenomenon under investigation further. Five teachers were interviewed to find their views on CTAs and their influence on teachers' practices. The stories given below which were recorded during the interviews contain their views. The way in which these stories were developed is given in the last paragraph of page 56. The names used here are pseudonyms (fictitious names) so as to protect the anonymity of the teachers.

4.2.1 Pearl

Pearl is a young lady teaching Grade 9 Natural Science in a township school. Her school is a medium size school with learner population of more or less 860 learners. Pearl's classes are medium size classes, the number of learners in her classes range between 40 and 47. Pearl has a B.Ed degree. Her major subjects include Biology and Mathematics, so she is qualified to teach natural science. She has been teaching for three years and has attended inservice-training. She said she is given good support by her superiors and her students behave very well. Her school is marginally resourced and this is what she had to say concerning CTAs:

Pearl thinks that the purpose of CTAs is to strengthen and capacitate the school based assessment. She thinks that this purpose is fulfilled but to a very limited extent because some teachers don't take CTAs seriously and some teachers don't understand CTAs. Pearl said she administers CTAs in her classes and other teachers in her school do CTAs in their classes. She said learners don't feel comfortable with CTAs because the work required by CTAs is sometimes above learners' level of understanding. She believes that learners are not adequately prepared for CTAs because CTAs come very late in the year, only to find that most of the work required by CTAs was not covered in the class. Pearl believes that CTAs influence teachers' practices and her practice is also influenced by CTAs. In her lessons she now uses strategies that are aligned to CTAs a lot, for example, group work.

Pearl believes that critical thinking and problem solving are necessary skills in science and technology. She said: "*Learners are actively engaged when solving problems, and this helps them to develop their critical thinking and reasoning skills. When they are used with group work they promote interaction and therefore enhance interpersonal skills*". So, critical thinking and problem solving should be among the key components of teaching and learning, especially in Natural Science and Mathematics. Pearl uses them a lot in her classes. She said some of the problems she uses in her classes are similar to those in CTAs but some are different. She reckons that CTAs influence the use of critical thinking and problem solving in her classes. Pearl believes that group work is necessary because students can assist each other very well if they work in groups. She said group work enforces co-operation among learners, therefore it can help to develop communication skills, tolerance and respect which are the key components of social fiber. She engages group work a lot now in her classes and she agreed that this is due to CTAs influence on her work. She said prior to the introduction of CTAs she was not using group work a lot in her classes.

Concerning practical work and investigations, Pearl thinks that they are very useful in the teaching and learning of science. She said: "*Practical work promotes logical reasoning and makes science concepts more realistic through experience. They can also be used to enable the learners to comprehend and carry out instructions*". She engages practical work and investigations in her classes and agreed that their use is influenced by CTAs. Pearl said projects are necessary in teaching and learning as they allow the students to produce tangible products. She said this enables them to put their science knowledge into practice and can help the teacher to assess how capable students are using their scientific knowledge in real world situations. Pearl thinks that projects should be used in Grade 9 Natural Science. She said: "*Projects improve learners' psycho-motor skills, and can improve their skills of conducting research*". She said she gives projects to her Grade 9 Natural Science classes, but not very often. She said she usually gives one or two projects per year. She agreed that the use of projects in her classes is influenced by CTAs. Pearl said field work has a role to play in school science, especially in Life Science. She said

learners can be given work that they can do outside the class, like observing certain plants or animals. Also they can be taken on an excursion, like visiting the zoo or farm. She gives field work to her learners and she reckons that the use of field work in her practice is influenced by CTAs.

About self and peer assessment, Pearl said they are necessary because in this way learners are allowed to evaluate themselves. She said she allows learners to assess themselves and to assess other learners. She said the use of self-assessment and peer-assessment in her practice is influenced by CTAs. Pearl said she was not prone to allowing the learners to assess themselves prior to CTAs but now she does. Pearl said she prefers learner centered teaching strategies like group work and inquiry. She said her choice of teaching strategies is influenced by CTAs. She said CTAs are learner centered assessment tasks and therefore need learner centered teaching strategies.

About the problems associated with CTAs, Pearl said the work required by CTAs is sometimes above Grade 9 level of understanding. She said this frustrates the learners because they can't make sense of the stuff that they are faced with. She said examiners should consult grade nine teachers and grade nine text books when setting CTAs so as to reduce the problems encountered with CTAs. Pearl believes that CTAs could be useful tools to improve education in S.A. if they are administered more properly. She said CTAs should be set in such a way that they are at Grade 9 learners' cognitive level (level of understanding). Secondly, she said they should be brought to schools a little bit earlier so that there will be enough time to deal with them properly. Pearl said their CTAs marks are moderated internally but have never been moderated externally. She thinks that it could be better if CTAs are incorporated into the quarterly assessments in schools so that they are done properly. She said this could help to reduce the unnecessary pressure brought by CTAs at the end of the year, and this could make CTAs to be more fruitful.

4.2.2 Sipho

Sipho is a middle age male teaching in a rural school. He has been teaching for twelve years now. His school is a medium size school. The number of learners in his school is more or less 900. Sipho said learners are crowded in his classes. The numbers of learners in his classes range between 55 and 65. Sipho has Secondary Teachers Diploma (STD) and his major subjects are Mathematics and Physical Science. His teaching experience is more than 10 years and he has undergone several inservice training programmes. Sipho is not happy about the support he gets from his superiors. He said his students don't behave very well and his school is poorly resourced. Sipho has this to say about CTAs:

Sipho said the purpose of CTAs is not clear, but he thinks that they were introduced to show the teachers how they should set their assessment tasks in schools. He doesn't think that the purpose of CTAs is achieved. He indicated that there are problems with CTAs. He said: "*CTAs are brought to schools very late in the year, so there is not enough time to deal with them properly. CTAs are not administered properly so they disturb programs and activities in schools*". He also said that in most cases you will find that CTAs are above the level of Grade Nine learners, so the learners don't make sense of CTAs, they frustrate learners. Sipho said they administer CTAs in his school because it's a departmental policy. Sipho said he doesn't think that learners feel well about CTAs. He said even the teachers don't feel well about CTAs. He said learners are not prepared for CTAs as they are above the level of Grade Nine learners. He thinks that CTAs should be tried at grade eleven or twelve. Sipho said he doesn't think that CTAs influence teachers' practices. He said: "*CTAs are divorced from daily activities of the school so they don't influence teachers. CTAs are just tasks that don't fall within the scope of Grade Nine learners and are not understood even by teachers, so how can they influence teachers?*". He said CTAs and daily school activities are separate entities, so CTAs don't influence teachers' practices.

Sipho thinks that critical thinking and problem solving are important in the teaching and learning of science. He said science in general concentrates on problem solving, so

critical thinking and problem solving should be used. He engages critical thinking and problem solving in his classes. He said the problems he uses are not same as those in CTAs and he said the use of problem solving and critical thinking in his classes is not influenced by CTAs. Sipho said group work could be a good teaching strategy if a teacher has small classes. Sipho agreed that he engages group work in his classes, but he doesn't use it often. He said his classes are too big for group work to be fruitful. He said the use of group work in his classes is not influenced by CTAs.

On practical work and investigations, Sipho said they are sometimes necessary because they help to highlight some complimentarity between theory and practice. But he said he doesn't think that they should be used more often at Grade Nine level especially if the school doesn't have proper facilities like an equipped laboratory. He said he uses practical work and investigations in his classes but not so often. He said they sometimes waste a lot of time if a teacher has big classes and doesn't have proper facilities like in his case. He said the use of practical work and investigations in his classes is not influenced by CTAs. Referring to projects Sipho said they are not very useful in early science. He said: "*Projects waste a lot of teaching time when used in lower classes. Also, this method is only useful to schools that are well resourced and with well motivated students*". He said his school is poorly resourced and learners are not motivated much. He said learners in rural areas sometimes don't take education seriously, they lack role models that will motivate them and inspire them to learn and have positive attitude towards education. Sipho said he doesn't give projects to Grade Nine learners. On field work he said it wastes a lot of time just like projects. He said he doesn't give field work to his classes.

Regarding self and peer assessments, Sipho said they are useful *sometimes*. He said he engages self and peer assessment in his classes but to a very limited extent. He said the use of self and peer assessment in his classes is not influenced by CTAs. On teaching strategies, Sipho said he prefers *direct teaching* because it's suitable for big classes. He said the choice of this teaching strategy is also not influenced by CTAs.

Concerning problems associated with CTAs, Sipho said CTAs are very difficult and they are above Grade Nine level. He said learners don't understand CTAs and some times even teachers don't understand them. To solve this problem he said the standard of CTAs should be lowered to that of Grade Nine level of understanding. He said examiners should not use a *university* standard at Grade Nine level. Also, he said, there should be a program that will be followed from the beginning of the year which incorporates CTAs to everyday teaching activities in schools. Sipho said CTAs are not useful in improving the standard of education in S.A. He said this is so because both teachers and learners don't understand CTAs. He said their CTA marks are moderated internally but are not moderated externally. Sipho said for CTAs to be useful, they should be administered such that they can be incorporated in everyday activities of the school. Also, he said, CTAs should be set in such a way that they can be understood by Grade Nine learners. Sipho thinks that CTAs should be abolished or put up to grade eleven or twelve classes.

4.2.3 Phumelele

Phumelele is a young teacher teaching natural science in a rural school. She has been teaching for 7 years. Her school is a medium size school with a learner population of about 780. The number of learners in her classes ranges between 45 and 48, so she is teaching medium size classes. Phumelele graduated with a B. Ped degree and had since furthered her education, now she has B.Ed. Honours degree. Her school is poorly resourced and her learners are not keen to learn. She also said that the support she gets from her superiors leaves much to be desired, and her story with regard to CTAs is as follows:

Phumelele thinks that the purpose of CTAs is to promote a common standard of assessment at Grade Nine and to direct school-based assessment. She thinks that this purpose is fulfilled. She said CTAs are assessment tasks that are administered over a longer period of time, and this is unusual in South African schools. She said CTAs are set such that they can support the growth and development of learners. She said this makes CTAs to be more aligned to the principles of OBE assessment. She said that she has

noticed that some of grade nine teachers in her school have changed their assessment style to resemble that of CTAs. She administers CTAs in her classes and other teachers in her school do CTAs. Phumelele feels that learners don't feel comfortable with CTAs and are not adequately prepared for CTAs. She said the language used in CTAs is sometimes above the level of grade nine learners, and the tasks in CTAs are sometimes above grade nine level of understanding. Phumelele believes that CTAs, as external assessment, influence teaching practices. Sher said her teaching practice is also influence by CTAs. She said CTAs have influenced her way of setting assessment tasks. She now use assessment tasks similar to those in CTAs and she also allows more group work and pupil presentations in her lessons.

Phumelele believes that critical thinking and problem solving are the corner stones of science education. She said these should be the fundamentals of teaching and learning in science. She said problem solving leads to deeper understanding of subject matter and this helps the learners to remember important ideas and concepts of the Learning Area. She said: "*Problems motivate students to learn more and increase their self confidence. Problems promote creativity in the class and improve general problem solving abilities*". She also said we need good problem solvers in the society today. She said she uses critical thinking and problem solving a lot in her classes. She said some of the problems she uses in her classes are similar to CTAs but some are different. She said the use of critical thinking and problem solving in her classes is influenced by CTAs. Phumelele believes that group work is necessary to facilitate co-operative learning in the class, and co-operative learning is important in OBE as it involves constructivism. She said: "*Group work inculcates the sense of responsibility in learners. It makes them to be less reliant on the teacher and more reliant to each other and to their own abilities, capabilities and skills*". She also said co-operative learning promotes interpersonal and communication skills. She said she uses group work a lot in her classes, it is the teaching strategy she uses the most. She said the use of group work in her practice is influenced by CTAs, but also influenced by OBE philosophy.

Phumelele said practical work and investigations are very important in the science curriculum. She said they give concrete evidence of scientific concepts and phenomena. She said: "*Practical work and investigations are useful in developing process skills like observing, comparing, measuring, estimating, sorting, classifying, information recording, interpreting, hypothesizing, planning and carrying out investigations*". She uses practical work and investigations in her classes. She said the investigation tasks that she gives to her students are sometimes similar to those in CTAs, but sometimes different. She said the use of practical work and investigations in her practice is, to a certain extent, influenced by CTAs. Phumelele said projects are useful in science classes. She said they allow learners to show their skills and ability of applying science knowledge. She agreed that projects should be used in Grade 9 Natural Science classes, but should be limited to one or two projects per year. She said she gives projects to her classes and she reckons that the use of projects in her practice is influenced by CTAs. Phumelele said field work is important in science but it's not a big deal if only but a few excursions are curried out in a year. She said she gives field work to her learners but not very often. She said the use of field work in her practice is not influenced by CTAs.

Phumelele said self and peer assessments are necessary in teaching and learning. She said they can help to improve learners' confidence. She said she allows learners to assess themselves and to assess other learners. She agreed that the use of self and peer assessment in her class is influenced by CTAs. Phumelele said the teaching strategy she prefers the most is group work. She says learners learn very well if they work in groups. She said the choice of her teaching strategy is influenced by CTAs.

With regard to problems associated with CTAs, she said CTAs come very late in the year only to find that the work required by CTAs is not covered in the class in some cases. Phumelele said it could be better if the section A of CTAs is brought to schools earlier in the year so that teachers can make sure that the work required by CTAs is covered in the class. Phumelele said CTAs are useful assessment tasks, they can improve teaching and learning in South Africa. She said CTAs sometimes involve "learn by doing" tasks, therefore they incorporate learner centered strategies which is the common trend in

teaching and learning nowadays. She said their CTAs marks are moderated internally but not externally. Phumelele said the government should set a programmed that will be followed to make CTAs to be more aligned to everyday activities of school, and this could make CTAs to be more meaningful and more fruitful.

4.2.4 Brian

Brian is a young man teaching in a township school. He teaches in a big school. The number of learners in his school is more or less 1200. Brian's classes are medium size classes. The number of learners in his classes is between 42 and 46. Brian has a B.Ed degree, his major subjects are mathematics and physical science. He has been teaching for 4 years. He said he enjoys good support from his superiors and his students behave very well. His views on CTAs are given below:

Brian thinks that the purpose of CTAs is to ensure that assessment in schools really assesses the key competencies of the curriculum. He thinks that this purpose is achieved. He said:

> "*The key competences of OBE curriculum include critical and creative thinking; problem solving; interpersonal skills; organizational skills; communication skills; group and team processing; information evaluation and interpretation; and values and attitudes. CTAs target these competences and therefore they* (CTAs) *will influence the teachers to promote these competences in learners*".

Brian administers CTAs in his classes and other teachers in his school do CTAs. Brian said initially learners don't feel well about CTAs but as the assessment continues they become accustomed to them. Brian doesn't think that learners are adequately prepared for CTAs, but they are set in such a way that learners can learn from them and therefore they end up getting on well with them. Brian believes that CTAs influence teaching practices and his practice is influenced by CTAs. He said CTAs have taught him how to integrate related outcomes of the learning area. In most cases, he said, a single activity in CTAs

combines a number of different assessment methods and outcomes and therefore facilitates integration.

Brain said critical thinking and problem solving help the learners to improve their thinking skills and problem solving capabilities. He said at work places and in real life general problem-solving skills are necessary. He said:

> "*Most of students studying science end up taking careers in the field of science, engineering and technology. Science students therefore need to be versed with critical thinking and problem solving as these are the skills they will need the most in their fields of study*".

He said he uses critical thinking and problem solving a lot in his classes and their use is influenced by CTAs. Referring to group work, Brian said in South Africa we use Outcomes Based Education (OBE) and OBE is based on constructivist epistemology or philosophy. He said constructivism stresses that learners should be actively involved when constructing knowledge or learning. He said this is achieved if students work in groups, so group work is necessary in such situations. He said he involves group work a lot in his lessons. He agreed that the use of group work in his classes is influenced by CTAs. He said he increased the use of group work in his classes after the introduction of CTAs.

Brian believes that practical work is very important in science curriculum for the following reasons:

1. It develops the cognitive and practical skills in learners.
2. It develops scientific values and attitudes in learners.

Brian engages practical work and investigations in his classes. The investigation tasks he uses in his classes are sometimes the same as those in CTAs but sometimes different. He said the use of practical work and investigations in his classes is influenced by CTAs.

Brian said projects are necessary in the science curriculum as they teach the students to be independent. When doing projects he said students are actively involved, so these are learner-centred activities. He also said projects are good in assessing the acquired knowledge and skills as learners are expected to produce tangible end-product. He concurs that projects should be used at Grade Nine level as this helps the learners to develop the skills of handling equipment at an early age. Brian gives projects to his grade nine classes. He said the use of projects in his practice is influenced by CTAs and they have shown him other ways of setting projects. Brian said field work is good but it can be substituted with projects. He doesn't use field work very much and its use is not influenced by CTAs.

Brian believes that self assessment and peer assessment are necessary in any teaching and learning situation. He said: "*Children learn better if they keep on assessing themselves and assessing their peers. Self-assessment and peer-assessment help to boost learners' self-esteem and increase their motivation in the class*". He said he engages self and peer assessment in his classes and their use is influenced by CTAs. Brian prefers discovery and inquiry strategies. He said the knowledge constructed in this way is conserved for a long time in the memory. He also said that these strategies motivate students intrinsically rather than extrinsically. He said his choice of teaching strategies is influenced by CTAs because they used these methods.

Brian said CTAs come very late in the year, as a result they don't have enough time to deal with them. He said this problem could be solved if CTAs are brought to school a little bit earlier so that they can (teachers) have enough time to deal with them. Brian said CTAs are useful tool to improve teaching and learning in South African schools. He said CTAs teach them the new ways of handling assessment in schools. Brian said their CTA marks are moderated internally but not externally. Brian said the government should seek new ways of administering CTAs. He said they must be administered in such a way that they don't exert unnecessary pressure on teachers and students. He said they should not be brought to schools very late in the year. He said if CTAs are brought too late in the year they create unnecessary pressure for teachers and students.

4.2.5 Mitchell

Mitchell is a young lady teaching in a township school. Her school is a medium size school with a learner population of 745 learners. Mitchell's classes are medium size classes. The number of learners in her class is between 35 and 40. Mitchell graduated in a university with a B.Sc. degree and had since studied further and now she has a B. Ed degree. She has been teaching for a couple of years and has undergone some inservice training. She said she gets a good support from her superiors and the students in her classes are very well behaved. Mitchell enjoys teaching natural science and this is what she had to say about CTAs:

Mitchell thinks that the purpose of CTAs is to show the standard and the level at which assessment tasks should be and thus establish consistency in school-based assessment. She thinks this will improve the validity and reliability on school-based assessment. In this way CTAs assist in improving the accuracy of assessment process and assessment tools in schools. She thinks that this purpose is fulfilled because she has noticed that her colleagues have changed their style of setting assessment tasks to resemble that of CTAs, and she has also changed her setting style. Mitchell does CTAs in her classes and other teachers in her school do CTAs. Mitchell said initially learners seem not to be happy with CTAs but as the time goes on they become acquainted with them and begin to feel comfortable with them. She said CTAs are done over a long period of time and this allows learners to learn from them and then become comfortable. She said she does not think that learners are adequately prepared for CTAs. She said tasks in the CTAs are not same as those in learners' book, but as CTAs are low-stake exams which are carried over a long period of time, learners end up coping with them. She said some learners end up enjoying CTAs. Mitchell believes that CTAs do have an influence on teaching practice and her teaching practice is also influenced by CTAs. She said:

"*CTAs have taught me how to attain the design-back principle in assessment, the idea that each component of learning should be included in the assessment. They* (CTAs) *have*

also taught me how to attain the high-expectation principle, the concept that assessment tasks should be challenging and involve real-world situations".

She said assessment tasks shouldn't just be simple routine tasks that learners do everyday in the class, but assessment tasks should allow learners to demonstrate a deep level of understanding of the subject matter. CTAs link the classroom work to real world situations. In this way the assessment helps in supporting the growth and development of learners.

Concerning critical thinking and problem solving, Mitchell linked these to critical outcomes of our OBE. She said the first and foremost critical outcome of our outcomes-based education system states that "*learners will be able to identify and solve problems and make decisions using critical and creative thinking*". This shows that critical thinking and problem solving are the foremost skills targeted by our education. She said this is very good since these are the skills needed at the workplace and in the society in general. She said:

> "*We are living in the 21st century and we are a part of the global village. Globalization means that citizens of various countries should be able to compete in global market. In order to achieve this objective we need people who are profound thinkers, so we need to teach critical thinking and problem solving in our schools*".

She said problem solving can help learners in the following ways:

1. Problem solving teaches learners to make informed decisions and judgements. In this way learners are forced to justify their actions or ideologies.

2. Problem solving, in case of group work, forces the learners to talk to each other and thus help them to improve their communication skills and their interpersonal abilities.

3. Problem solving can help the learners to evaluate their understanding and thus identify flaws and problems in their internalized knowledge, concepts or ideas.

4. Problem solving can help learners to activate their pre-knowledge and construe similarities and differences between certain concepts and contexts.

5. Problem solving can force the learners to elaborate on their acquired knowledge, information, concepts or on their problem solving methods. In this way learners are taught to be reflective of their ideologies or actions.

Mitchell says she engages critical thinking and problem solving in her practice. She said the use of critical thinking and problem solving in her practice is influenced by CTAs. Referring to group work, Mitchell associated it with the second critical outcome of our OBE. This outcome states that "*learners will be able to work effectively with others as a team, group, organization or community*". To achieve this outcome, according to Mitchell, group work should be engaged. She said:

> "*Group work enforces co-operation among the learners and this helps them to improve their interpersonal skills. It forces learners to talk, argue, discuss and voice out their ideas, and in this way they share ideas. It teaches them to gather, summarize, compare, contrast and communicate their ideas. When presenting their ideas, it teaches them to explain and defend them when they are required to do so. In this way the learners learn to organize their ideas, test their ideas, retain or discard their ideas when proven to be wrong. So the learners learn to tolerate and respect each other, become acquainted with group dynamics and begin to understand their strengths and limitations*".

She further said that group work gives learners experience of being leaders, followers or subordinates, the experience which they will need in adult life. Mitchell said she uses group work a lot in her classes and she agreed that its use is influenced by CTAs.

Mitchell connected practical work and investigations to the fourth critical outcome. This outcome states that "*learners will be able to collect, organize and critically evaluate information*". She said this can only be achieved through the use of practical work and investigations. She said information collection, analysis, organization and evaluation are the process skills acquired through the use of practical work. She said investigations, on the other hand, teach the learners the skills of conducting research. She said she uses practical work and investigations in her classes and she affirmed that their use is influenced by CTAs. Mitchell said projects are very useful in the science curriculum because they enable the learners to develop a deeper understanding of the subject mater. She said they also help in developing learners' critical thinking and problem solving skills. She said projects help the learners to progress from what they already know or understand to what they need to understand or new knowledge and in this way the leaner knowledge horizons are broadened. She said projects can sometimes be fun and enjoyable and in this way learners are motivated to learn even more. She believes that projects should be used in grade nine science. Mitchell uses projects in her grade nine classes though not very often. She said the use of projects in her classes is in a certain way influenced by CTAs. Mitchell said:

> "*Field trips are important in science education in many ways. They allow learners to get first hand information or get the 'real world experience' of certain concepts or phenomena. Sometimes we can't get the real world in the classroom so we must go 'out there' to experience it*".

She said field work provides learners with experience that can not be attained in the classroom situation. For an example, the life in the farm, zoo or game-park can not be brought to the classroom. She said we can't have animals, plants, bushes, forests, rivers, oceans etc. in the classroom. She said if they are learning about ecosystems they have to

go outside, because it is not in the class but it's out there. She said this arouses interest and enthusiasm in the subject in general or in a particular unit of work. She said field trips can inspire the learners to have a good attitude towards environment and natural resources. She said they are very much useful in the science curriculum. Mitchell uses field work in her practice and she said its use is influenced by CTAs.

Mitchell said self-assessment and peer-assessment are necessary for boosting learners' level of motivation. She said: "*They motivate learners intrinsically and thus help in increasing their willingness to learn*". She said self assessment and peer assessment relieve stress from learners because they allow the learners to work in freedom without striving for external rewards like high marks. She engages self and peer assessment in her classes and she says their uses are influenced by CTAs. Mitchell said she prefers participative methods like group work, inquiry, questions and answer, etc. She said she likes these methods because they make learners to be active in class, and not just passive and waiting for the teacher to spoon-feed them with knowledge. She said these methods make the learners to take the central role in the learning process, and this makes learners to be responsible and take the control of their learning. She said the choice of her teaching strategies is influenced by CTAs.

Mitchell said the problem with CTAs is that they are brought very late in the year, so there is no enough time to deal with them. She said CTAs should be brought a little bit earlier in the year, say by July or August, so that teachers can have enough time to deal with them. Mitchell said CTAs are useful tools in improving teaching and learning in South Africa because they change teachers' attitudes. She said teachers look into curriculum and assessment in another way since the advent of CTAs. Mitchell said their CTA marks are moderated internally but she has never seen officials from the department of education coming to moderate their CTA marks. Mitchell said the government should try to improve the administration of the CTAs so as to make them to be more helpful.

4.2.6 Interviews Summary

The interviews with the teachers revealed that CTAs do have some influence on pedagogical practices of teachers. Four out of five teachers concurred with this. The interviews also showed which practices are influenced and most importantly, how are they influenced. This could not be attained with questionnaires only. For an example, some interviewees said they have changed their teaching strategies to learner centred ones because CTAs are learner centred assessment tasks so they need learner centred strategies. Some of the teachers said they have changed their ways of setting assessment tasks to resemble that of CTAs.

All of the four teachers that agreed that CTAs influence their pedagogical practices indicated that critical thinking, problem solving, group work, practical work, investigations and projects are influenced by CTAs. It transpired that the skills promoted by CTAs include communication skills, interpersonal skills, problem solving skills, investigation skills, organizational skills and information processing skills. Also, it became apparent that CTAs promote learner-centred practices or strategies. There was no consensus when it came to field work. Some said field work is influenced by CTAs but some said it is not influenced by CTAs. Some give field work to learners but some don't. But something also was peculiar about field work, it is that all teachers think that it should not be used often.

The interviewees pointed out also that there are some problems with CTAs. The participants said CTAs arrive at schools very late in the year so they don't have enough time to deal with them. Some said the level of work in the CTAs is above grade nine learners. Some said the language used in CTAs is above the learners' level. They also said that there is no syllabus at grade nine so they don't know the things that will be in the CTAs. They said sometimes when CTAs come they find that the work in the CTAs is not covered in the class. In this way they think that learners are not adequately prepared for CTAs. However they believe that these problems can be sought out and CTAs can therefore become more fruitful in improving the teaching and learning in South Africa.

One way of improving the administration of CTAs could be to bring them early in the year so that teachers will have enough time of dealing with them and also to align them to Grade Nine level of understanding.

4.3 Conclusion

The data collected has given a good profile of the phenomenon under speculation. The questionnaires showed how CTAs influence Grade 9 Natural Science teachers' practices. It also showed how other factors like teaching experience, inservice training, teachers' support, resource availability, class sizes, learners' character affect the influence of CTAs on teachers' practices. The interviews have revealed how CTAs influence teachers' practices. From the above information it has became apparent that CTAs to a certain extent influence pedagogical practices. In the next chapter the conclusion based on the interpretation of the analysis will be given.

CHAPTER 5

CONCLUSION

The main purpose of the study was to investigate the influence of CTAs on the pedagogical practices of Grade 9 Natural Science teachers. The research sought to find how teachers view CTAs and what influence do CTAs have on pedagogical practices of Grade 9 Natural Science teachers. Interviews were used to find the views of the teachers on CTAs and also to find the influence of CTAs on pedagogical practices of teachers. The findings of the research are discussed below:

5.1 Interviews' Findings

Five teachers were interviewed to find the views of teachers on CTAs and the influence of CTAs on teachers' practices. The interviews revealed that teachers view CTAs as good educational tools to improve the quality of Natural Science education in South Africa. Four out of five teachers that were interviewed agreed that their pedagogical practises are influenced by CTAs. The interviews revealed that the categories of work that are influenced the most by CTAs include group work, problems solving, critical thinking, practical work, investigations and projects. From the interviews it transpired that the competencies targeted by CTAs include thinking skills, problem solving skills, communication skills, group processing skills, interpersonal skills, organizational skills, information evaluation skills, information interpretation skills, social values and attitudes. For an example, Pearl (the interviewee) said: *"Critical thinking and problem solving are necessary skills in science and technology. Learners are actively engaged when solving problems, and this helps them to develop their thinking skills and reasoning skills. When used in group work problem solving promotes interaction and enhances interpersonal skills"*. The skills mentioned by Pearl here include thinking skills, problem solving skills, communication skills and interpersonal skills. Phumelele (the other interviewee) said: *"Co-operative learning promotes interpersonal and communication skills"*. She further

said: *"Practical work is useful in developing process skills like observing, comparing, measuring, estimating, sorting, classifying, information recording, interpreting, hypothesizing, planning, and carrying out investigations"* The skills mentioned by Phumelele here are necessary skills needed to enhance problem solving skills, communication skills, organizational skills, information evaluation skills and information interpretation skills. It can be concluded that CTAs seek to promote the attainment of these skills in the classroom and therefore they influence teachers to emphasize or enhance the attainment of these skills. Four out of five teachers that I interviewed affirmed that the promotion of these skills in their classes is influenced by CTAs. Teachers indicated also that the use of self-assessment and peer-assessment in their classes is influenced by CTAs. They said self-assessment and peer-assessment help to boost learners' self esteem and thus motivate them to learn. For example, Brian said: "*Children learn better if they keep on assessing themselves and assessing their peers. Self-assessment and peer-assessment help to boost learners' self-esteem and increase their motivation in the class*". This was reiterated by Mitchell. Referring to self-assessment and peer-assessment she said: "*They motivate learners intrinsically and thus help in increasing their willingness to learn*". To me it seems as if CTAs tend to influence the teachers to comply with the aims of science education. One of the aims of science education is that "science curriculum should foster an interest in science, curiosity and willingness to speculate about and explore the world. Learners should be able to engage in communication of and about science, value evidence and scepticism, and question scientific claims made by others. Learners should be able to identify and investigate scientific questions, draw evidence-based conclusions and make informed decisions about their own health and wellbeing" (National Curriculum Board, 2009, p. 5).

The interviews also revealed that CTAs tend to influence teachers to engage learner-centred strategies in their classes. For example, Mitchell said that she prefers to use participative methods like group work, inquiry learning and question and answer method in her classes. She said: "*I like these methods because they make learners to be active in the class, and not just passive learners waiting for a teacher to spoon-feed them with knowledge. These methods make learners to take the central role in their learning*

process, and this makes them to be responsible and take control of their learning". Mitchell agreed that the usage of these methods in her classes is influenced by CTAs. Brian also indicated that he uses participative methods in his classes. He said he prefers discovery learning and inquiry learning. Defending the usage of these methods in his class he said: "The knowledge constructed in this way is conserved for a long period of time in the memory. These strategies motivate learners intrinsically rather than extrinsically". He also affirmed that the usage of these methods is influence by CTAs. This means that CTAs accentuate the practices that promote participative approach in teaching and learning. A participative approach in teaching and learning refers to teaching and learning situations where the learners are allowed to participate actively in teaching and learning activities (Vakalisa, 1996). The methods used in such an approach include inquiry, discovery, discussion, question and answer, problem solving, cooperative learning and simulation (Mahaye, 1996). The participative approach in teaching and learning is characterized by flexibility, real-life situation contexts, democratic learning climate, co-operation spirit, individual responsibility and leaner empowerment (Vakalisa, 1996). Learners can be empowered through discussions, evaluation, experimental learning, pupils' questions and development of positive self-concepts. These are the findings of the research. For an example, referring to group work Mitchell (the interviewee) said: *"It forces learners to talk, argue, discuss and voice their ideas; and in this way they share ideas. It teaches them to gather, summarize, compare, contrast, and communicate their ideas"*.

From what transpired above to me it seems as if teachers view CTAs as good educational tools that seek to promote the competences, skills, values, knowledge and understanding that are held by teaching for understanding and teaching for quality models (Killen, 2007). Teaching for understanding means that teachers teach in such a way that learners are allowed to construct their knowledge and that they can think and act flexibly, applying the knowledge they constructed (Killen, 2007). Flexible thinking means that learners have the ability to take the knowledge they have constructed and apply it to different situations than the ones they learned in the classroom. If learners can apply their

knowledge in complex and unfamiliar situations, that would mean they learned with understanding.

Teaching for understanding entails the engagement of strategies that are associated with teaching for quality model or Quality Teaching Model (QTM). Quality Teaching Model refers to the use of pedagogical practices that are designed to help the learners to develop a deep understanding of important concepts, skills and ideas (Killen, 2007). This model suggests that this can be attained if learners are engaged in higher order thinking (intellectual quality), learning focuses on deep knowledge of the subject (significant knowledge), pedagogy focuses on producing deep understanding (knowledge flexibility) and learners are engaged in substantive communication about what they are learning (in-depth communication). CTAs assist or influence the teachers to engage or develop these strategies.

According to Killen (2007), quality teaching is associated with Quality Learning. Quality Learning refers to the learning that is meaningful (correspond to the needs of learners), deep (justifiable knowledge), transformative (fit to real world problems) and metacognitive (allows ways of monitoring and promoting one's own learning) in the class. He further said that such learning includes mastery of content, understanding of concepts and development of strategies for asking good questions regarding the subject matter and exploring new ideas. CTAs influence the pedagogical practices that promote these competences. To me these are competences accentuated or upheld by constructivist (Killen, 2007). If it is so then I can conclude that CTAs tend to influence the teachers to adopt or accept constructivists' ideology or constructivism.

5.2 Questionnaires' Findings

The research found that CTAs have influence on teachers' practices. The analysis of the results showed that 84% of the respondents are influenced by CTAs. From this I can conclude that the majority of the respondents are influenced by CTAs. The analysis showed that female teachers are more influenced by CTAs than their male counterparts,

though to a very limited extent. This difference could however be due to the fact that the number of respondents in the research was low. Only 32 teachers responded positively to the research questionnaires that were sent to them.

Other factors that could affect the influence of CTAs on teachers' pedagogical practices were investigated. Some of these factors are associated with school profile and they include catchment area, class size and resource availability. The research found that catchment area has an effect on the CTAs' influence on teachers. CTAs seem to have more influence on teachers who teach in urban areas than to those who teach in rural areas or townships areas. From this I concluded that teachers working in urban areas are more likely to be influenced by CTAs than those who work in rural areas or township areas. Sipho (the interviewee) said learners from rural areas sometimes don't take education seriously because they lack role models that motivate and inspire them to have positive attitude toward education. If learners are not motivated to learn it is not easy to work with them. This could be the reason why teachers from rural areas are influenced the least by CTAs. Another reason could also be the fact that schools in rural areas are not visited frequently by subject advisors, and this makes teachers in rural areas not keen to heed curriculum innovations. I have noticed that most of rural schools in my sample are poorly resourced. Ten out of fourteen teachers who teach in rural schools in my sample indicated that their schools are poorly resourced. This could also be the factor that caused teachers in rural schools to be influenced the least by CTAs. It seems as if the lack of resources makes teachers to be reluctant to heed curriculum innovation.

The class size also seems to have an effect on the CTAs influence. The research found that teachers who have small number of learners in their classes are influenced the most by CTAs than those who have big classes. From this it can be concluded that the number of learners in the class affect the influence of CTAs on teachers. I have observed that teachers interact easily with learners in small classes and I think that this makes it to be easy for teachers to work with learners in small classes. I think this is the reason why teachers with small classes tend to be influenced more by CTAs. Teaching strategies like group work and problem solving, which were shown by the study to be influenced the

most by CTAs, are easily employable in small classes as compared to big classes. For an example Sipho (the interviewee) said: *"I don't use it often* (group work). *My classes are so big for group work to be fruitful"*. This shows that group work is not easily employable in big classes. Sipho also said that he prefers direct teaching because it is suitable to big classes. Other teaching strategies like inquiry, practical work, investigations which are associated with CTAs are also not easily employable in big classes. This is a possible reason why teachers teaching in big classes tend not to be influenced by CTAs.

Another factor that was found to have an effect on the influence of CTAs on pedagogical practices of teachers is availability of resources. The results of the research showed that CTAs influence teachers in well resourced schools more than those who work in marginally resourced or poorly resourced schools. This could be attributed to the fact that teachers who work in well-resourced schools get all the material they need in their lessons.To me this means that it is easier to work with CTAs in well resourced schools. This implies that teachers who teach in well resourced schools will be keen to work with CTAs as opposed to those who work in marginally or poorly resourced schools. Teachers in well resourced schools usually get all materials they need in their classes and are therefore not troubled by curriculum innovation. From these results I could conclude that teachers in poorly resourced schools are not keen to heed the curriculum innovations. Scholtz, Watson and Amosun (2004) came to the same results in their study of teachers' response to curriculum innovation.

What also transpired in the research is that poorly resourced schools have large numbers of learners in their classes. Eleven out of fifteen teachers who teach in poorly resourced schools indicated that their classes have large numbers. As it has been established that teachers teaching in big classes tend not to be influenced by CTAs, this means that the lack of resources will make this situation to be even worse. It also became apparent that teachers in poorly resourced schools do not get good support from their supervisors. Eleven out of fifteen teachers who teach in poorly resourced schools scored 12 and less in the support column. This corresponds to poor and very poor on the Likert scale for

support. The lack of resources and poor support makes teachers to be even less influenced by CTAs.

In my study I also investigated other factors that can affect on the influence of CTAs on the pedagogical practices of teachers. These include teaching experience, inservice training, support the teachers receive in their schools and learners' characters or behaviour. Pearson's correlation coefficient was used to investigate the influence of each factor and the findings are discussed below:

In case of experience and CTAs influence, Pearson's correlation coefficient showed that there is a ***weak positive*** correlation between experience and CTAs influence. This means that as the teaching experience increases, the teachers tend to be more influenced by CTAs. Since this correlation is weak, this means that teaching experience affects the CTAs influence on teachers' pedagogical practices to a very little extent. But nonetheless, CTAs influence is affected by teaching experience.

The inservice training showed the same trend as experience. The calculation of Pearson's correlation coefficient showed that there is a ***weak positive*** correlation between inservice training and CTAs influence. This means that as the number of inservice trainings increase, the teachers are likely to be more influenced by CTAs, but this influence will be very minimal. Since the inservice trainings aim at improving teacher's instructional strategies, it means that as teachers become more and more equipped with teaching strategies, through the employment of inservice training, the higher will be the chances of teachers being influenced by CTAs.

Another factor that was investigated is the support the teachers receive in their schools. The calculation of Pearson's correlation coefficient showed that there is a ***strong positive*** correlation between support and CTAs influence. This means that as the level of support increases (from very poor to excellent), the chances that the teachers will be influenced by CTAs also increases. This means that the teachers are likely to be more influenced by the CTAs in the schools where there is a good support mechanism for teachers.

The last factor that was investigated in this category is the learners' character or behaviour. This pertains to the behaviour of learners in the classes. It was investigated whether the behaviour of the learners, as it increases from very poor to excellent, does affect the influence of CTAs on teachers' practices. Again Pearson's correlation coefficient was determined to investigate this factor, and it was found that there is a ***strong positive*** correlation between learner's character and CTAs influence. This means that teachers with well-behaved learners are more influenced by CTAs than teachers with ill-behaved learners. This is probably caused by the fact that it is easier to work with well-behaved learners than with ill-behaved learners.

Questionnaires also looked into the strategies the teachers used in their classes. These could be deduced from their frequency of giving certain categories of work to the learners. Teachers were asked to indicate their frequency of giving certain categories of work in their classes. This was done so as to extrapolate which categories of work are probably influenced by CTAs. When teachers were asked to indicate which categories of work they use often in their classes (column 10 in coded data table). The data showed that group work, problem solving, pupils presentation, self assessment, practical work and report writing are used the most. Group work scored 69%, problem solving scored 65%, pupils' presentation scored 59%, self assessment scored 56%, practical work scored 53% and report writing scored 51%. When they were then asked to indicate which categories of work, in their opinion, are influenced by CTAs (column 11 in coded data table), the research found that group work, problem solving, report writing, practical work, pupils' presentation and investigations are influenced the most. Group work scored 78%, problem solving scored 72%, report writing scored 59%, practical work together with pupils' presentation scored 56% and investigations scored 53%. From these findings we can conclude that group work, problem solving, report writing, pupils' presentation, practical work, self assessment and investigations are influenced the most by CTAs. As these are problem oriented and learner centred strategies, it can be concluded that the *learner centred and problem oriented pedagogical practices* (or strategies) are influenced the most by CTAs. As learner-centred strategies are associated with constructivism, it

means CTAs also promote the constructivist philosophy in schools. Constructivism stresses that learners should be active in the class, i.e. they should be involved in negotiations, discussions, comparing, interpreting, engaged on hand-on activities, etc. (Cobern, 1995; Chen, 2003) . If learners are active it is believed that they are constructing knowledge, and therefore there are truly learning (Killen, 2007). This is consistent with OBE, so it means that CTAs also aim at supporting or promoting OBE philosophy.

To verify the reliability and validity of the above findings, the measure of central tendency and dispersion was done. The mean, mode and median were calculated and they were found to be very close to each other. This means that there is high level of reliability in the data. The data skewness was calculated and was found to be -0,77. This meant that there is a strong negative skewness in the data. This means that there are quite a few outliers in the data. The standard deviation was also calculated and was also found to be 7,8. The value of standard deviation is very low. This means that there is a low variability in the data. As there is a low variability in the data, it can be concluded that the findings of the research are trustworthy. This means that there is a high level of reliability and validity in this research.

5.3 Implications

Both the qualitative and quantitative analysis showed that CTAs tend to influence teachers toward constructivist ideology. For an example, both methods showed that group work, problem solving, practical work, learners' presentations, report writing, self-assessment and peer-assessment are influenced the most by CTAs. These are categories of work that are associated with constructivism because they are learner-centred and allow learners to be active when they are engaged in them (Killen, 2007). In constructivism, constructing an understanding requires that the learners have the opportunity to articulate their ideas, to test those ideas through experimentation and conversation, and to consider connections between the phenomenon that they are examining and other applications of the concept (Chen, 2003). Constructivism suggests that learners should be given opportunity to discuss and clarify their experiences because

it encourages self-organization and reflective abstraction (Chen, 2003). For this to occur smoothly it calls for everybody who is involved in education to play his/her role correctly. These include teachers, learners, government officials and the state. For CTAs to succeed in improving education all of these people must play their roles.

The first and foremost people to play their role correctly are the teachers. They are the ones who are directly implementing the curriculum in the classrooms. The teachers should push the learners to think as clearly as they can in their construction of knowledge. The teachers should not merely provide experience for learning, but should keep on asking questions and keep on interpreting the data that comes from learners' engagement. The teacher should allow the learners to make errors as this will show what conceptions do learners hold in their minds with regard to a phenomenon. The teacher should elicit an explanation as to how the learners have arrived at their answers or concept so as to modify them. The teacher should provide different presentations of the concept so as to allow the learners to discover their errors and construct the correct ideas.

The teachers should prepare their lesson plans such that there is elicitation phase, comparison phase, resolution phase and application phase (Killen, 2007) In the elicitation phase the teacher engages learners in some activity that will require them to reveal their pre-knowledge. In the comparison phase the teacher brings forth the concept that will challenge learners existing understanding and then allow them to discuss, negotiate and debate about the concept. The learners will compare, contrast, sort, interpret and classify the emerging concept or idea in relation to their existing knowledge. In the resolution phase the teacher guides learners to modify their knowledge and resolute the mismatch between their pre-knowledge and their experience. In the application phase learners are allowed to apply their new knowledge and explore the phenomenon even further.

The role of the teacher does not just end with the lessons presentations. It also involves the responsibility of creating an environment that is conducive to quality learning. It implies that teachers should also be very good in this activity for the CTAs to be more fruitful in education. This implies that teachers should create environment that is

supportive, encouraging and focused on learning (Killen, 2007). When creating such an environment the teachers should bear the following in mind:

(i) Create the environment that is safe and comfortable, both physically and psychologically.
(ii) Structure learning experience to take learners purposefully towards meaningful long-term goal.
(iii) Create learning experiences that are interesting, challenging and realistic, and that give learners opportunities to work collaboratively.
(iv) Give learners experiences of using and discussing the methods of the field of study.
(v) Value learners' efforts and help them to see the importance of their effort in successful learning.
(vi) Trust the learners and give them some say in what they learn, and also how and when they learn. Allow them to participate in establishing the classroom norms.
(vii) Expect learners to work hard to achieve high standards that have been made explicit.
(viii) Require learners to be responsible for their behaviour and learning. (Killen, 2007, p. 25)

The learners should also play their role correctly in their learning process. Constructivism places learners at the centre of learning process. Learners should examine their existing knowledge, reorganize if and use it to construct knew ideas. Learners, and not the teacher, are responsible for gathering, organizing, justifying, defending, proving and communicating their ideas. These types of tasks place a very high cognitive demand on the learners, and therefore learners should be responsible for their learning process. We can see from the CTAs that the curriculum now is no longer placing an emphasis on content memorization but on knowledge construction. Learners are no longer required only to memorize the content which they will repeat in the test. Learners are required to take a more responsible role in managing their learning than it was in conventional instruction. This requires that learners become autonomous in the management of their

own learning. Learners should be engaged in dialogues when they are required to work in groups. Learners should have inquisitive mind, i.e. they should ask questions related to the concept they are working on, both to their peers and teacher. Learners should not be afraid of hard work when it comes to knowledge construction. A constructivist approach requires that learners should think both about the concept and the process of learning the concept (Chen, 2003). If students are lazy they may not buy in to this teaching and learning approach and this would contravene the aims and objectives of constructivism and hence retard the influence of CTA in teaching and learning.

The government also must play its role correctly if CTAs influence is to succeed. The research found that CTAs tend to more influence to teachers with small number of learners in their classes. This means that if the teacher : learners ratio in the classes can be reduced, we can reap more benefits from the CTAs. This could mean that the Department of Education should revise its Post Provisioning Norm (PPN) policy. This means that the Department of Education should employ more teachers so as to reduce the teacher : learners ratio.

The teachers complained that CTAs come too late in the year, so there is not enough time to work with CTAs. In so doing CTAs therefore do not benefit learners optimally. If we are to succeed with CTAs it means they must be brought to schools a little bit early in the year. This could mean that the Department of Education should re-visit its assessment policy, especially that part which relates to Grade 9 assessment. The Department of Education should change its policy such it allows for CTAs to be brought to schools early in the year.

The research also found that teachers who receive good support in their schools tend to be influenced more by CTAs. This means that the managers at schools, ward SEMs, circuit managers and officials from district offices should give more support to teach to enable the CTAs to influence teachers more. Also in terms of resources, the Department of Education should improve the availability of resources in schools. The research

findings showed that CTAs influence teachers more in the schools that are well-resourced.

5.4 Future Research

My study found that teachers are not happy about the manner in which CTAs are administered. They said they are brought to late in the year and therefore there is not enough time to deal with them properly. They also said that they are not given the scope of the work that will be covered in the CTAs and when the CTAs come they find that the work required by CTAs was not covered in the class. They also complained about the level of work and the language used in CTAs. They said the level of work and language used in CTAs are sometimes above the level of Grade 9 learners. My proposed future research therefore could be to look into these problems and how to address them. The future research should investigate how can CTAs be brought earlier to schools and what will be the effect of bringing CTAs earlier to schools. The research could also look into the influence of giving teachers the scope of the work that will be covered in the CTAs. Another research could be content analysis. The research could look into the level of work and language used in the CTAs. The research should investigate whether the level of work and language in the CTAs is at Grade 9 learners' level of understanding

5.5 Conclusion

The research found that CTAs influence teachers' practices, and that they influence them towards achieving quality teaching and quality learning. They have been found (CTAs) to influence or promote learner centred and problem oriented pedagogical practices. These include group work, problem solving, critical thinking, practical work, investigations, projects, report writing, pupils' presentations, self assessment and peer assessment. CTAs have a lot to be commended for in the attempts at achieving quality education in South African schools.

There are problems though with CTAs. The study found that CTAs arrive very late in the year and therefore there is not enough time to deal with them properly. Also it was discovered that CTAs are sometimes above the Grade Nine level of understanding and also the language used is sometimes above the Grade Nine level. If these problems are addressed CTAs can be good tools for improving teaching and learning in South African schools. Another possible study could be to investigate how CTAs can be administered or improved so that they could be more fruitful or helpful in South African education.

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APPENDIX A

Teachers' Questionnaire

1. Qualifications and Gender

A: In the spaces given below indicate your academic and/or your professional qualification(s).

Qualification	Year in which it was obtained	Institution from which it was obtained
1.		
2.		
3.		
4.		

B. Indicate (using X) the level of your highest content qualification in Natural Science.

Course	Level 1	Level 2	Level 3	Level 4
College Physical Science				
College Biology				
University Physics				
University Chemistry				
Biochemistry				
Botany				
Zoology				

C: Please indicate your gender status with X: Male [ ] Female [ ]

2. Teaching Experience

(a) How long have you been teaching? _____

(b) How long have you been teaching Natural Science? _____

(c) Do you enjoy teaching? Yes [ ] No [ ]

Give reason for your answer: _____

_____

(d) Do you enjoy teaching Natural Science? Yes [ ] No [ ]

Give reason for your answer: _____

_____

(e) How long have you been teaching in your current school? _____

(f) Do you prefer teaching in this school? Yes [ ] No [ ]

Give reason for you answer: _____

_____

(g) Which sections of natural science do like teaching the most?

_____

_____

_____

(h) Which sections of natural science do you dislike teaching the most?

_____

_____

_____

3. Inservice Training

(a) Have you ever attended any inservice training fro Natural Science? Yes [ ] No [ ]

(b) How many inservice trainings have you attended? _____

(c) Where were the inservice trainings held? _____

(d) Who organized the inservice trainings? _____

(e) How many days did the inservice trainings last? _____

(f) Which topics were covered in the inservice trainings? _____

_____

_____

_____

_____

(g) In your opinion, were the inservice trainings useful? Yes [ ] No [ ]

Give reason for your answer: _____

_____

(h) What you liked the most about the inservice trainings? _____

_____

(i) What you disliked the most about the inservice trainings? _____

_____

(j) Are you currently doing any studies to further your education? Yes [ ] No [ ]

(k) If your answer in (j) above is Yes, name the course and the institution at which you are studying: _____

_____

4. School Profile

(a) Give the characteristic of your school catchment area. Mark with X.

Rural	Township	Urban

(b) Class size: How big are your classes? Mark with X.

Less than 30	Between 30 and 50	More than 50

(c) Resources: How is your school resourced? Mark with X.

Poorly resourced	Marginally resourced	Well resourced

5. Support Mechanism

In the scale 1 to 5, rate the support you get at your school. Mark with X

How would you rate the support given by the following people to you?	**Very Poor**	**Poor**	**Good**	**Very Good**	**Excellent**
HOD	1	2	3	4	5
Deputy Principal	1	2	3	4	5
Principal	1	2	3	4	5
Subject Advisor	1	2	3	4	5
SEM	1	2	3	4	5
SGB	1	2	3	4	5

Other, specify:_____

_____

6. Pupils Characteristics

In the scale 1 to 5, rate the behaviour of the pupils in your science classes.

How are the pupils in your class?	**Never**	**Seldom**	**Sometimes**	**Often**	**Always**
Pupils like being in the class.	1	2	3	4	5
Pupils enjoy doing the work.	1	2	3	4	5
Pupils enjoy hard work.	1	2	3	4	5
Pupils are highly motivated.	1	2	3	4	5
Pupils work very hard.	1	2	3	4	5
Pupils are friendly.	1	2	3	4	5
Pupils work co-operatively.	1	2	3	4	5
Pupils are respectful.	1	2	3	4	5
Pupils work enthusiastically.	1	2	3	4	5
Pupils communicate freely.	1	2	3	4	5
Pupils listen attentively.	1	2	3	4	5
Pupils act confidently.	1	2	3	4	5
Pupils have sense of humour.	1	2	3	4	5
Pupils have good morals.	1	2	3	4	5
Pupils come to class early.	1	2	3	4	5

Other, specify: _____

_____

_____

7. Learners' Work

In the scale 1 to 5, rate your frequency of giving the specified work to your class.

How often do you give the following work to learners	**Never**	**Seldom**	**Sometimes**	**Often**	**Always**
Group work	1	2	3	4	5
Problem solving (Mathematical or theoretical)	1	2	3	4	5
Practical work (exercises)	1	2	3	4	5
Investigations (inquiry)	1	2	3	4	5
Projects	1	2	3	4	5
Field work	1	2	3	4	5
Report writing	1	2	3	4	5
Pupils presentations	1	2	3	4	5
Self assessment	1	2	3	4	5
Peer assessment	1	2	3	4	5

Other, specify: _____

_____

_____

_____

_____

_____

8. The CTAs Influence on Work

(a) Which of the following categories of work in your opinion is influenced by CTAs? Indicate with X.

Given Work	**Yes**	**No**
Group work		
Problem solving (Mathematical or theoretical)		
Practical work (exercises)		
Investigations (inquiry)		
Projects		
Field work		
Report writing		
Pupils presentation		
Self assessment		
Peer assessment		

Other, specify: _____

_____

_____

_____

_____

(b) Do you use previous years CTAs questions in your lessons? Yes [ ] No [ ]

APPENDIX B

Interview Questions

The following questions will be asked in the interviews:

1. In your opinion, what is the purpose of CTAs?

2. Do you do CTAs in your class?

3. How do learners feel about CTAs? Are they comfortable with CTAs?

4. In your opinion, could you say CTAs influence teaching practices?

5. What is your view on the use of critical thinking and problem solving? Could you say that their use is influenced by CTAs?

6. What is your view on the use of group work? Would you say that it is influenced by CTAs?

7. What is your view on the use of practical work and investigations is science curriculum? Are they influenced by CTAs?

8. What is your view on the use of projects in the science curriculum? Are they influenced by CTAs?

9. Do you give field work to your learners? Is the use of field work in your teaching practice influenced by CTAs?

10. What is your view on the use of self-assessment and peer-assessment? Could you say that the use of self-assessment and peer-assessment in your practice is influenced by CTAs?

11. Which teaching strategy do you prefer the most? Could you say that your choice of teaching strategy is influenced by CTAs?

12. What problems have you encountered with CTAs? What should be done to reduce those problems?

13. Could you say that CTAs are useful tools for improving teaching and learning in South African schools?

14. Are your CTAs marks moderated internally and externally?

15. Is there anything you want to say about CTAs?

APPENDIX C

Consent Form

I_____ agree to participate in the research conducted by Siphesihle Cele for his Masters Degree at University of KwaZulu-Natal. I have been told that the aim of the research is to investigate the influence of CTAs on the pedagogical practices of Grade 9 Natural Science teachers. I have been told that my participation in the research is voluntary, I am not forced to participate in the research if I don't want to. I have been told that there is no monetary benefit that I will gain by participating in the research. I have been told that my anonymity and my confidentiality will be protected in the research. I have been told that my name and my school's name will not be used in the report, save pseudonym where necessary. I have been told that my right to privacy will not be violated in the research. I was told that there will be no questions invading my privacy will be asked in the research. I have been also told that my autonomy will be upheld in the research, and I can pull-out off the research at anytime if I feel tat I am not comfortable with the proceedings without incurring any inconveniences. The researcher has shown me his clearance certificate from the University of KwaZulu-Natal and from KZN Department of Education. I therefore agree to participate in the research.

Signed by participant_____at _____on_____

APPENDIX D

Interview Sample

Teacher A

(The researcher greets the respondent, introduces himself and explains about the purpose of the research and the interview. Questions and answers of the interview follow hereinafter.)

Researcher: Good morning mam.

Respondent: *Good morning.*

Researcher: My name is Sihle Cele, I am a student from the University of KwaZulu – Natal. I'm conducting a research on the influence of CTAs on the pedagogical practices of Grade 9 Natural Science teachers. There are some few questions about CTAs that I would like to ask you. I would be very grateful if you can give me your honest answers to these questions. Can we start?

Respondent: *Yes we can.*

1. **My first question concerns the purpose of the CTAs. In your opinion, what is the purpose of CTAs?**

   I think the purpose of CTAs is to strengthen and capacitate the school based assessment.

   Do you think that this purpose is fulfilled?

   I think this purpose is fulfilled but to a very limited extent

   Why do you think so?

   Some of the teachers, if not the most, don't understand CTAs.

2. **Do you do CTAs in your class?**

   Yes, I do them.

   Do other teachers in your school do CTAs?

   Yes they do..

3. **How do learners feel about CTAs? Are they comfortable with CTAs?**

   Learners don't feel comfortable about CTAs. The work required by CTAs is sometimes above learners' level.

   Do you think learners are adequately prepared for CTAs?

   No, learners are not adequately prepared for CTAs. CTAs come very late in the year, only to find that most of the work required by CTAs was not covered in the class.

4. **In your opinion, could you say CTAs influence teaching practices?**

   In a certain way, yes.

   Is your teaching practice influenced by CTAs?

   Yes, it is influenced by CTAs.

   In what way is your practice influenced by CTAs?

   In my lessons, I now use strategies aligned to CTAs a lot, for an example, group work.

5. **CTAs seem to involve critical thinking and problem solving a lot. What is your view on the use of critical thinking and problem solving?**

   Critical thinking and problem solving are necessary skills in science and technology. Learners are actively engaged when solving problems, and this helps them to develop their thinking and reasoning skills. When used in group work, problem solving promotes interaction and therefore enhances interpersonal skills. So, critical thinking and problem solving should be among the key components of teaching and learning, especially in science and maths.

   Do you engage critical thinking and problem solving in your class?

   Yes, I do.

   Are the problems you use similar to those in CTAs?

   Some of the problems I use are similar to those in CTAs but some are different.

Would you say the use of critical thinking and problem solving in your class is influenced by CTAs?

To a certain extent, yes.

6. **In CTAs, learners are sometime asked to work in groups. What is your view on the use of group work?**

   Group work is necessary because students can assist each other very well if they work in groups. Group work enforces co-operation among learners, therefore it can help to develop communication skills, tolerance and respect which are the key components of social fibers.

   Do you involve group work in your teaching practice?

   Yes, I do.

   Is the use of group work in your class influenced by CTAs?

   Yes, it is influenced by CTAs. Although I was using group work prior to CTAs advent, now I use it more often.

7. **CTAs sometimes involve practical work and investigations. What is your view on the use of practical work and investigations is science curriculum?**

   Practical work and investigations are very useful in teaching and learning of science. Practical work promotes logical reasoning and makes science concepts more realistic through experience. They can also be used to enable the learners to comprehend and carry out instructions.

   Do you use practical work and investigations in your class?

   Yes, I use them.

   Are the investigation tasks that you use similar to those in CTAs?

   Some are the same as those in CTAs but some are different.

   Could you say that the use of practical work and investigations in your class is influenced by CTAs?

   Yes, it is influenced by CTAs,

8. **CTAs sometimes involve projects. What is your view on the use of projects in the science curriculum?**

   Projects are necessary as they allow the students to produce tangible products. This enables them to put their science knowledge in to practice and can help the teacher to assess how capable students are in using their scientific knowledge in real world situations.

   Do you think that projects should be used in grade 9 science?

   Yes, they should be used. Projects improve learners' psycho-motor skills, and can improve their skills of conducting researches.

   Do you give projects to your grade nine science class?

   Yes I do, but not very often. Usually I give one or two projects per year.

   Could you say that the use of projects in your class is influenced by CTAs?

   Yes it is influenced by CTAs.

9. **CTAs sometimes involve field work. What is your view on the use of field work in the teaching and learning of science?**

   Field work has a role that it can play in school science, especially in Life science. Learners can be given work that they can do outside the class, like observing certain plants or animals. Also they can be taken to an excursion, like visiting the zoo or farm.

   Do you give field work to your learners?

   Yes I do.
   Is the use of field work in your teaching practice influenced by CTAs?

   To a certain extent, yes.

10. **In CTAs, learners are sometimes asked to assess themselves or assess other students. What is your view on the use of self-assessment and peer-assessment?**

    Self assessment and per assessment are necessary because in this way learners can learn to evaluate themselves.

Do you use self-assessment and peer-assessment in your class?

Yes, I allow learners to evaluate themselves or each other.

Could you say that the use of self and peer assessment in your practice is influenced by CTAs?

Definitely. Prior to CTAs I was not prone to allowing the learners to evaluate themselves, but now I do.

11. Which teaching strategy do you prefer the most?

I prefer teaching strategies that are learner centered, like group work, inquiry, etc.

Could you say that your choice of teaching strategy is influenced by CTAs?

In one way or another, yes. CTAs are learner centered assessment tasks and therefore need learner centered strategies.

12. What problems have you encountered with CTAs?

Sometimes the work required by CTAs is far above grade 9 level of understanding. This frustrates learners a lot when they can't make sense of the staff that they are faced with.

What could be done to reduce these problems?

Examiners should consult grade 9 teachers and grade 9 text books when setting CTAs.

13. In your opinion, could you say that CTAs are useful tools for improving teaching and learning in South African schools?

They are useful, but they should be administered more properly.

Can you briefly explain why do you say so or what do you mean?

First of all, CTAs should be set such that they are at grade 9 learners' cognitive level so that learners can understand them. Secondly, they should be brought to schools a little bit earlier so that there will be enough time to deal with them properly.

14. Are your CTAs marks moderated internally and externally?

They are moderated internally but not externally.

15. Is there anything you want to say about CTAs?

I think it could be better if CTAs are incorporated to the quarterly assessments that are done in schools. This could help to reduce the unnecessary pressure brought by CTAs at the end of the year. This will make CTAs to be more fruitful.

Researcher: Thank you for your time and your participation in this research mam, you have helped me a lot. It was pleasure talking to you, hope to see you again in a situation different from today's one.

Respondent: *Thank you for your confidence in me too. I also hope that we shall see each other again.*