

**AN EXPLORATION OF BIOLOGY TEACHERS' PRACTICE WITH REGARD  
TO PRACTICAL WORK AND HOW IT RELATES TO THE NCS-FET LIFE  
SCIENCE POLICY DOCUMENT**

**BY**

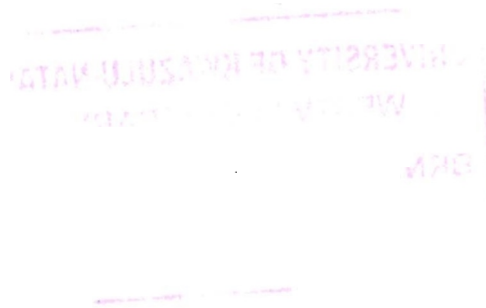
**ASHEENA PILLAY  
(2004)**

A dissertation submitted in partial fulfillment of the requirements for the degree of  
Master of Education in the department of Science Education in the School of  
Educational Studies, University of KwaZulu-Natal.

**Supervisor: Dr. Busisiwe P. Alant**

## DEDICATION

To my loving, tolerant and incredibly supportive husband **Danny**, my dearest children **Kamesh** and **Mishka** for your patience and understanding and my parents **Krishna** and **Shoba Singh** for your motivation and believing in me.



## ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to the following people who all made this work reach its fruition.

**Dr. Busi Alant**, my mentor and supervisor, for her excellent guidance, tireless patience, constant encouragement, assistance and motivation from the inception of this research study to the final preparation of this thesis.

My colleagues **Mrs Syrie Matthew, Mr Ruben Govender and Mr Desmond Moodley** for assisting with piloting the questionnaire

The biology educators who formed part of the survey

**Reena Moodley and Chantal Kaulasar** of Howick West Primary for assisting in typing of the research material

**Bongi Jila**, my home manager, for stepping in and taking over whenever I needed her assistance.

## **ABSTRACT**

When democracy was achieved in South Africa there was a need to create an education system that served the needs of all South Africans. An education system which would produce literate, creative, critical and productive citizens. This led to the introduction of OBE, Curriculum 2005 and the National Curriculum Statement policy document. The principles on which the current South African education system is based has been borrowed from countries like Canada, England and Scotland. Although there are educational changes, the legacy of apartheid continues to be felt in the education system. There still exists an unequal distribution of resources both physical and human. Many previously disadvantaged schools do not have laboratory facilities nor qualified biology educators. This unequal distribution of resources impacts on teaching and learning.

The successful implementation of the NCS-FET Life Science Policy Document hinges on teachers. Teachers are expected to through their teaching espouse the philosophy of the NCS-FET Life Science Policy Document. The majority of teachers teaching in South African schools had their training in a “content era,” where it was amiable to transfer as much content knowledge as possible to learners, with little inquiry and the accompanying practical work. The NCS-FET Life Science Policy Document embraces the idea of learner centredness and emphasises the development of basic and integrated science process skills, in its

first learning outcome. These educational changes imply a re-examination of the ways in which activities may have been conducted in the past, and at present. The context in which practical work is done in South Africa is different from the context in which practical work is done in countries like Canada, England and Scotland.

This study uses an open-ended questionnaire and focus group interview to investigate teacher conceptions of practical work, the types of practicals teachers use to teach science process skills. The purpose is to get a deeper insight and understanding of teacher practices within a South African context, taking into account the effects of the legacy of apartheid. The study also highlights the possible challenges the teachers face in embracing the NCS-FET Life Science Policy Document.

# DECLARATION

I, Asheena Pillay, declare that the research involved in my dissertation entitled, An Exploration of Biology teachers' practice with regards to practical work and how it relates to the NCS-FET Life Science Policy Document, submitted in partial fulfillment of the M.Ed in science education is my own and original work.

.....  
Asheena Pillay

.....  
Date

## **TABLE OF CONTENTS**

	<b>PAGES</b>
<b>CHAPTER ONE</b>	
1.1. Introduction	1
1.2. Changes in the South African Education System	1
1.3. Purpose of this Study	4
1.4. Critical questions	4
1.5. Rationale	5
1.6. Significance of the study	7
1.7. Clarification of terms	7
1.8. Preview of Subsequent chapters	11
<b>CHAPTER TWO</b>	
2.1. Introduction	12
2.2. Conceptual Framework	12
2.2.1. Introduction to Constructivism	13
2.2.2. Cognitive constructivism, social constructivism, and sociotransformative constructivism	15

2.2.3. Relationship between Constructivism and the philosophy of the NCS-FET Life Science Policy Document	18
2.2.4. Constructivism and practical work	19
2.3. Past studies	21
2.4. Conclusion	27

### CHAPTER THREE

3.1. Introduction	28
3.2. Why this study involves qualitative data	28
3.3. Development of research instrument	29
3.4. Credibility of data gathered	32
3.4.1. Analysis of critical question one	33
3.4.2. Analysis of critical question two	34
3.4.3. Analysis of critical question three	34

### CHAPTER FOUR

4.1. Introduction	36
4.2. Critical Question One	36
4.3. Critical Question Two	39
4.4. Critical Question Three	45



4.5.	Summary of Findings	47
4.6.	Conclusion	48

## CHAPTER FIVE

5.1.	Introduction	49
5.2.	Discussion on Patterns that emerged	49
5.3.	Challenges facing teachers in espousing the NCS – FET Life Science policy document	53
5.4.	RECOMMENDATIONS	56
5.5.	Implications of this study	57
5.6.	Conclusion	58

Appendix	61
Bibliography	80

## **CHAPTER ONE**

### **1.1. INTRODUCTION**

The aim of this chapter is to firstly present an overview of the changes in the South African education system, secondly to state the purpose of the study, its critical questions, rationale and significance, clarify terms and finally to present a preview of the chapters that follow.

### **1.2. CHANGES IN THE SOUTH AFRICAN EDUCATION SYSTEM**

When democracy was achieved in South Africa in 1994, to overcome the legacy of apartheid in education, outcomes based education (OBE) was introduced. The principles of OBE were borrowed from first world countries such as England, Scotland and Canada (Department of Education (DoE), 1997). The previous education system was teacher-centred, emphasis was placed on what the teacher sought to achieve, the syllabus was rigid, non-negotiable and based on Christian National principles. It was viewed as inflexible and incapable of equipping learners with the ability to cope with the real world.

Against this backdrop OBE encourages a learner-centred and an activity based approach to education, putting the learner first in the learning process. It emphasizes the promotion of critical and creative thinking; the ability to work

effectively within a team/group/community; and the ability to organize and evaluate data. In addition, OBE places much emphasis on the ability to communicate effectively and transfer knowledge and skills gained to solve problems in their everyday lives (DoE, 1997). This shift in focus is expected to impact on our county's economic and scientific development.

OBE forms the foundation of the National Curriculum Statement, which espouses the principles of social transformation; high knowledge and high skills; integration and applied competence to overcome the social injustices that previously existed in education (National Curriculum Statement G10-12 overview - DoE, 2003)

The development of science process skills is embedded in the new curriculum and is encompassed in the first of the three learning outcomes of the NCS-FET Life Science Policy (DoE, 2003 ) The first learning outcome concerns scientific investigation / practical work. Currently, it is expected that teachers ensure the acquisition of a range of 38 science process skills, by learners as directed by the interim Biology curriculum and the guideline document for National Examination (DoE: Interim core syllabus for Biology, 2000, Guideline Document for National Examination, 2002). Practical work / investigative work provides an ideal platform for the development of learner-centred science process skills.

The legacy of apartheid continues to be felt in the education system. Institutions were established along racial lines and saturated with the doctrines of apartheid

and entrenched inequality. As a result there was an unequal distribution of resources. Historically advantaged schools and colleges tended to be well resourced while historically disadvantaged institutions tended to be poorly resourced. This unequal distribution of resources impacts on teaching and learning. It presents a daunting challenge for implementing the national curriculum, which hinges on teachers. Teachers are expected to espouse the philosophy of the NCS-FET Life Science Policy Document in their teaching. The implementation of the national curriculum therefore makes great demands on them. The majority of teachers currently teaching in South African schools had their training in a “content era” during which it was acceptable to transfer content knowledge to learners with little accompanying inquiry and, consequently practical work. There are some teachers who have had little or no training in the life science area, yet are expected to implement the NCS-FET Life Science Policy Document, emphasizing the development of high knowledge and high skills.

Studies by Black and Atkin (1996 ) and Van der Akker (1998) show that teachers experience great difficulties in making the sort of changes demanded by the learner-centred curriculum initiatives currently being implemented in the world. Adequate professional development for the teachers, who have to implement the changes in the classroom, is crucial for curriculum reform (Fullan & Hargreaves, 1992; Bell & Gilbert, 1996). These studies serve as a yard stick to indicate that

professional development and support is necessary to assist teachers in the successful implementation of the new curriculum.

### **1.3. PURPOSE OF THIS STUDY**

This study is an investigation that aims to determine teachers' conception of practical work. Central to this conception are the types of practicals teachers use to teach basic and integrated science process skills in biology and the process skills they seek to develop in learners. This study was conducted with the aid of an open-ended questionnaire and a focus group interview.

### **1.4. CRITICAL QUESTIONS**

This study aims to answer the following research questions:

1. What are teachers conception of practical work ?
2. What type of practicals do teachers claim to use in order to teach science process skills in the current biology syllabus?
3. Which science process skills do teachers focus upon when they engage with practical work?

## 1.5. RATIONALE

As a teacher of Biology in the Phoenix North Region of KwaZulu-Natal, I have had the opportunity to assist subject advisors in the field of Biology with grade 12 moderation of continuous assessment of learners and teacher portfolio files and have made the following observations:

- Much of the practical work is of a “cook book” nature, where the learner merely follows instructions which are similar to following a recipe;
- Many factors influence the implementation of practical work in schools e.g. lack of funds and resources, time constraints, large classes;
- There is a need to develop basic and integrated science process skills in our learners so that they can excel not only at basic science process skills but also at integrated science process skills;
- As educators we need to provide more opportunities for our learners to use and develop their science process skills during practical work, so that these skills, once developed, can be transferred and applied to the learners’ everyday life. This would help learners in understanding scientific and technological principles involved in household devices. It would enable them to use science processes in solving problems that occur in everyday life; to understand and evaluate media reports on

scientific developments; and to make decisions related to personal health, nutrition, and lifestyle;

- There is a need to equip learners with the necessary basic and integrated science process skills to meet the needs and demands of industry and the business sector. This development will impact on our country's economic growth and will play a role in increasing the potential for the training of scientists in South Africa.

Most existing research on the use of practical work in the teaching of science process skills has been conducted in American, Australian and Israeli schools. This research will enable me to bring to the fore teacher conception of practical work, and the types of practical work teachers use to teach science process skills. As such, it will serve as a basic for identifying which science process skills teachers focus on when engaging with practical work. In this way, this study will provide a means of assessing the extent to which science process skills developed in learners meet with the philosophy of the NCS-FET Life Science Policy Document. This study aims to illuminate teacher practices with regards to practical work, highlight the challenges teachers are faced with in implementing the NCS-FET Life Science Policy Document. It seeks, in other words, to "set the stage for reform" so we can truly aspire to the philosophy of the NCS-FET Life Science Policy Document.

## **1.6. SIGNIFICANCE OF THE STUDY**

The findings of this study would be useful to all the parties involved in reviewing the content of the biology syllabus and reviewing assessment of practical work in the senior secondary phase, as part of continuous assessment. These include: Teachers, curriculum developers, subject advisors, textbook authors, teacher training institutions.

## **1.7. CLARIFICATION OF TERMS**

The term “practical work” and “science process” are key terms in this research project. They have different meanings to different individuals and hence need to be clarified for the purpose of this study. The term “practices” will also be clarified.

### **1.7.1. SCIENCE PROCESS SKILLS / PROCESS SKILLS**

By their nature, science process skills are difficult to define as there are a number of different meanings associated with them, each with its particular claims. According to Dillashaw (1993) developing science process skills in science education involves scientific thinking or reasoning ability. This description is vague, as it does not tell us what science process skills are, or the procedure involved in developing science process skills.



Screen (1986) describes science processes as the sequence of events which is engaged in by researchers while taking part in a scientific investigation. Goh *et al.* (1989) refer to science process skills as being related to proficiency in the "doing" aspect of science and cognitive and investigative skills. This definition hints at a correlation between cognitive and investigative skills and is based on Piaget's theory of cognitive development. In terms of this theory, knowledge is personally constructed, hence the "constructivist" perspective of learning. Padilla (1990: 1) describes science process skills as *"a set of broadly transferable abilities appropriate to many science disciplines and reflective of the behaviour of scientists. The process involves scientific method, scientific and critical thinking"*.

The fact that these skills are broadly transferable makes them important for learners to acquire, whether they are heading for careers in science or not. Scientifically literate, will require skills in order to make informed decisions about how they will allow science to affect their lives.

Padilla grouped science process skills into two types "basic and integrated skills." Basic science process skills include observing, inferring, measuring, recording information, classifying, predicting. Integrated science process skills, on the other hand, include controlling variables, defining operationally, hypothesizing, interpreting data, formulating models and designing experiments, (Padilla, 1990; Duggan & Gott, 2002; Revised National Curriculum Statement Natural Science, 2002). The definition by Padilla will be used for the purpose of

this study, as it reflects that a hierarchy of the processes. The more complex or integrated process skills rely upon more “sophisticated” cognitive abilities or “critical thinking” while basic (simpler) process skills provide a foundation for learning the integrated skills.

### **1.7.2. PRACTICAL WORK**

Woolnough and Allsop (1985) describe practical work as exercises and investigations which provide learners with opportunities to act like problem solving scientists. It provides them with experiences which give them a “feel” of phenomena. This definition highlights the role of practical work in mastering science process skills while the learner is actively involved in knowledge construction / meaning making and understanding. Practical work can be used as a vehicle for engaging learners in science process skills. Woolnough and Allsop (1985) highlight the aims of practical work as:

- Allowing learners to get a “feel for their phenomena”;
- Developing practical scientific skills and techniques;
- Developing problem solving scientists. This definition focuses on the development of manipulative skills (hands-on activities) and cognitive skills (minds- on activities).

According to a later definition of practical work by Woolnough (1991) practical work refers to the performance of experiments or practical exercise with science apparatus, usually in a laboratory setting, but it can include any student activity that involves the basic ingredients of science and would be useful for all students. The first and second definition by Woolnough will be used in this study. It is seen to refer to all science activities that can be done in the laboratory, classroom, as well as in the garden and at home and involves both basic and integrated science process skills.

According to Wellington (1994) the dimension of practical work / investigation relate to the nature and extent of guidance given at all stages of the investigation, to identify who defines the problem and in terms of the openness of the problem. The kind of role that the teacher plays during practical work is crucial to the development of science process skills. The type / form of practical work done and the degree of guidance given by the teacher during practical work influences the types of science process skills developed in learners. These are intertwined with practical work: doing any type of practical work involves mastering science process skills.

### **1.7.3. PRACTICES**

The Oxford Dictionary (1999) defines practice as "*a means of improving ones skills or habitual action or carrying on*". Bennet (2001: 10) defines *practice* as

*“activities that occur in a socio- cultural setting.”* This study aims to bring to the fore teacher practices with regard to types of practical work teachers use to teach science process skills. Teaching and learning occurs in a socio-cultural setting, hence the relevance of Bennet’s definition. According to Bennet (2001), a researcher can gain information about the practices that occur within a community by using questionnaires and interviews purposively. This study will illuminate teacher practices with regard to practical work and the development of science process skills by using a questionnaire and a focus group interview.

## **1.8. PREVIEW OF SUBSEQUENT CHAPTERS**

Chapter two is a literature review. The literature review sets out to:

- Build a conceptual framework for the study;
- Identify past studies that have informed my research, while highlighting the discrepancy between local literature and international literature;
- Highlight the challenges teachers face in implementing the NCS-FET Life-Science Policy Document.

Chapter three focuses on the research design and methodology. Chapter four presents the data obtained from the questionnaires and focus group discussion. Chapter five finally discusses contextual factors that impact on teacher practice.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1. INTRODUCTION**

In this chapter I discuss the conceptual framework. The conceptual framework revolves around constructivism and shows how the philosophy of the NCS-FET Life Science Policy Document embraces the principles of constructivism. The literature review focuses on past studies done on practical work and science process skills both locally and internationally. Possible challenges that teachers face in the implementation of the NCS-FET Life Science Policy Document will be reflected on, based on emerging trends from past studies.

#### **2.2. CONCEPTUAL FRAMEWORK**

The conceptual framework sets out to:

- 2.2.1. Introduce constructivism as a framework;
- 2.2.2. Show how cognitive constructivism, social constructivism and sociotransformative constructivism differ in the way in which they encompass learner-centredness;
- 2.2.3. Highlight the relationship between constructivism and the philosophy of

the NCS-FET Life Science Policy Document;

2.2.4. Illuminate the link between constructivism and practical work.

### **2.2.1. INTRODUCTION TO CONSTRUCTIVISM**

This study is located in a constructivist framework. There are differing views on whether constructivism is an epistemology, a theory, a method or referent.

According to Driver and Oldham (1985) constructivism has encouraged teachers and curriculum developers to alter their perception of children as irrational and unknowing to that of children as cognizant beings. Fosnot (1986) describes constructivism as an epistemology that offers an explanation of the nature of knowledge and how human beings learn. Osborne (1996) presents the view that constructivism is neither a theory nor an epistemology, but rather an approach to teaching and learning. Despite the differing views on whether constructivism is an epistemology, theory, method or an approach to teaching and learning, the essential core of constructivism remains the same: learners actively construct their knowledge and meaning from their experience ( Novack & Gavin, 1984; Osborne & Wittrock, 1985; Fosnot,1986). In a constructivist setting, learning activities are characterized by active engagements, hands-on activities, inquiry, problem- solving, investigations, experimental design and collaboration with others (Bodner,1998),

The philosophy of the NCS-FET Life Science Policy Document reflects the principles of a learner- centred/activity based approach to education, and therefore, clearly embraces the constructivist principle. The creation of an effective learning environment is crucial in promoting a learner-centred approach to education. In such an environment, the learner can excel at developing both basic and integrated science process skills. In a learner-centred environment, the teacher takes on a less dominant role, serving as a guide, facilitator, co-explorer, who encourages learners to ask questions and formulate their own ideas and opinions. In the learning of science this relates to the learners designing, conducting, analysing and synthesize their own practicals. For learners to master both basic and integrated science process skills a learning environment for the development of these skills needs to be fostered. Learners will not excel at science process skills they have not experienced or been allowed to practice.

Constructivism will be used as a lens through which to examine what biology teachers report about their practices with regards to practical work and science process skills, hence to establish how teacher practices relate to the philosophy of the NCS-FET Life Science Policy Document. This will highlight possible challenges faced by teachers in implementing the NCS-FET Life Science Policy Document.

## **2.2.2. COGNITIVE CONSTRUCTIVISM, SOCIAL CONSTRUCTIVISM AND SOCIOTRANSFORMATIVE CONSTRUCTIVISM**

There are different types of constructivism e.g. trivial constructivism, radical constructivism, cognitive or individual constructivism and sociotransformative constructivism. Each has its own view of how learning occurs or the factors that influence learning. This study will focus on cognitive constructivism, social constructivism and sociotransformative constructivism.

### **2.2.2.1. COGNITIVE CONSTRUCTIVISM**

Cognitive constructivism is based on the work of Piaget, a Swiss psychologist, who studied the development of thought in children. Piaget believed that knowledge is acquired as a result of a life long constructivist process. In this process we try to organize, structure and restructure our experience in light of existing schemes of thought and modify and expand these schemes (Piaget, 1967). Piaget's view of how knowledge construction occurs focuses on internally driven mental activities of the individual child, a cognitive development that is seen to proceed in stages that are universal and predictable (Piaget, 1967; Fosnot, 1989; Flavell, 1992). For Piaget, maturation is a central factor in development, which is not influenced by social or cultural factors. According to Driver *et al.* (1994), learning from this perspective requires a well designed practical activity that challenges learners' prior conceptions, encouraging



learners to reorganize their personal theories. This perspective of constructivism illustrates the inadequacy of the teacher-centred approach of transmitting knowledge. According to Vadeboncoeur (1997), this view assumes that development is an ingrained natural biological process that is pretty much the same for all individuals, regardless of gender, race, class or the social or cultural context in which learning and living takes place. At the same time, cognitive constructivism is of the view that learning is an internalized and individual process that is not influenced by the socio-cultural environment in which learning occurs. This lack of concern for the socio-cultural distances it from the philosophy of the NCS-FET Life Science Policy Document.

#### **2.2.2.2. SOCIAL CONSTRUCTIVISM**

The views of social constructivism are based on the work of Vygotsky, a Russian psychologist. Vygotsky's work (1986) emphasizes the significance of culture and social context for cognitive development, which distinguishes social constructivism from cognitive constructivism. In social constructivism the focus shifts from the child as a solitary thinker to the child in the social context, where everyday concepts are integrated into a system of relational concepts through interaction, sharing and negotiation with others. In the learning environment, these "others", are seen as mentors (Howe, 1996). The school is seen as a socio-cultural setting where teaching and learning occurs. According to O' Loughlin (1996) this approach assumes that theory and practice do not develop

in a vacuum. It is shaped by the dominant socio-cultural setting, in which the teacher has an active role to play in knowledge construction and is a facilitator or guide. According to Rodriguez (1998), a shortcoming of this model is, however, that it ignores the socio-economic and multicultural complexity of schools. His argument is that while social constructivism focuses on enculturation and the zone of proximal development, it does not take into account socio-economic and multicultural complexities that could impact on the learning process and thereby disadvantage certain learners. In short, social constructivism does not take into account issues of social justice and therefore does not fully embrace the philosophy of the NCS-FET Life Science Policy Document.

#### **2.2.2.3. SOCIOTRANSFORMATIVE CONSTRUCTIVISM**

Sociotransformative constructivism takes into account how social, historical and institutional contexts influence learning and access to learning in schools (Rodriguez, 1998). This view of constructivism is used to explore how issues of power, privilege, ethnicity, gender and voice influence the when, why and how of what is to be learned (Rodriguez, 1998). It takes into account how issues of social justice such as race, gender, lack of resources; could be addressed to bring about transformation in education. According to Rodriguez (1998) sociotransformative constructivism could be used to make science more socially relevant and accessible to all children, by taking into account indigenous knowledge system and different world views. In this way it can be used as a

platform to work towards social justice in our classroom. Sociotransformative constructivism embraces the philosophy of the NCS-FET Life Science Policy Document with regards to social transformation, high knowledge and high skills, outcomes based education and valuing indigenous knowledge systems.

### **2.2.3. RELATIONSHIP BETWEEN CONSTRUCTIVISM AND THE PHILOSOPHY OF THE NCS-FET LIFE SCIENCE POLICY DOCUMENT**

The philosophy of the NCS-FET Life Science Policy Document (DoE, 2003) is based on the principles of social transformation; outcomes based education (OBE), learner centred or activity based education, high knowledge and high skills, human rights, inclusivity, environmental and social justice. In terms of the NCS-FET Life Science Policy Document, social transformation in education is aimed at ensuring that the educational imbalances of the past are redressed (DoE, 2003). OBE encourages a learner-centred and activity based approach to education and aspires to the following outcomes for learners to: develop critical and creative thinking, identify and solve problems, collect, analyse, organize and evaluate data; work effectively as part of a team; use science and technology effectively and critically; show responsibility towards the environment and demonstrate an understanding of the world.

Development of high knowledge and high skills is emphasized in the policy document and is linked to progression where learners will eventually develop

more advanced / integrated skills and knowledge (DoE, 2003). The interim Biology Curriculum (DoE, 2000) and Guideline document for National Examination (DoE, 2002) cites 38 process skills that a learner should develop. All learners need to be developed to their full potential and should have equitable opportunities for success and must be exposed to the many ways of processing information to make sense of the world. The NCS-FET Life Science Policy Document strongly embraces the principles of constructivism. This document advocates learner-centeredness and the creation of an effective environment for learners to engage in investigative and practical work, inquiry and project based learning, problem solving, and to work as part of a team.

#### **2.2.4. CONSTRUCTIVISM AND PRACTICAL WORK**

According to the NCS-FET Life Science Policy Document (2003: 8) learners are expected to explore and develop basic process skills and high level / integrated process skills. These skills will allow learners to think critically, design experiments and solve problems. These basic and high level / integrated process skills form the first learning outcome in the life science learning area. Practical work which involves "hands-on and minds-on" activities offers the space in which these skills could be nurtured and developed. The learning of science process skills is interrelated to the constructivist view of learning. According to Miller and Driver (1987) learning is seen as an active process of constructing meaning, involving an interaction between existing mental schemes and new sensory

inputs, rather than the mere reception of sensory data from “outside”. Learning, therefore, involves not only observation and classification, but also hypothesizing, designing and so on.

Teachers need to create an environment where these science process skills can be mastered by learners. Practical work is crucial in this regard. According to the NCS-FET Life Science Policy Document (2003) experimental skills include following instructions, observing, identifying, measuring and recording information, while data handling skills involve selecting, organizing, translation, manipulating data, inferring, deducing, analyzing, planning and designing investigations. In order to develop the above mentioned skills, learners must be provided with the opportunity to engage in different types of practical work that foster the development of these skills (Westbrook & Rogers, 1994). During practical work, the teacher is faced with the challenge to redefine his position to that of a guide and facilitator of learning, rather than an instructor. Learners must be given opportunities to plan, design and organize their own investigations so that they can develop integrated process skills or data handling skills. (Staer *et al.*, 1995). From this perspective teachers, clearly face the additional challenge of finding different resource material and assessment techniques.

### **2.3. PAST STUDIES**

This section focuses on some studies done on practical work nationally and internationally.

A study by Moodley (1972) focused on the assessment criteria used by Indian Schools in South Africa. This study examined the assessment criteria, prescribed by the new defunct House of Delegates education department for practical work. It found that practical work was done mainly to meet the demands of the prescribed assessment criteria and that time constraints and a lengthy syllabus prevented teachers from allocating time for learner-based practical work. Poliah (1993) focused on the attitudes of pupils and teachers to practical work in Indian Secondary Schools in the P.W.V. area (now Gauteng). This study correlated attitudes of pupils and teachers to achievement in practical work and found that pupil achievement in practical work was generally poor. Teachers advanced many explanations for pupils' poor performance, such as time constraints and a lengthy syllabus. Learners didn't have sufficient opportunity to do practical work.

De Beer (1993) investigated the value of practical work as a component of Biology teaching in South African schools. He found practical work in South Africa to be characterized by routine procedure, in which pupils merely follow instructions from textbooks. De Beer recommends that practical work be more learner-centred. Learners should be encouraged to design their own practicals so

that they can develop skills that can be transferred to their daily lives. For example such skills may assist them in understanding the scientific and technological principles involved in household devices.

De Beer's study indirectly focuses on the development of science process skills, through its observation that learners were merely following instructions from textbooks and its recommendation that learners be encouraged to design their own practicals. Collussi (1997) determined the status of practical work in historically white South African high schools. Collussi found that although practical work made Biology more real and interesting, (as reported by teachers and learners), little practical work of any kind is carried out due to a lengthy matric biology syllabus. His findings relating to the length of the syllabus are therefore similar to those of Moodley quoted above.

White (2002) conducted a study that aimed to establish if teachers have a command of science process skills. White tried to establish whether teachers included process skills appropriately in their teaching or if they themselves had difficulties with their own application of process skills. White's sample consisted of Grade 10, 11 and 12 teachers from poorly performing public schools in Mamelodi and Atteridgeville. The research findings reveal that teachers found it difficult to formulate a hypothesis, design a fair test, distinguish between dependent and independent variables and deal with abstract concepts such as ratios and proportion. On the basis of these findings, White (2002) recommends

that in service training for teachers must be refined to focus on the development of the application of science process skills. White's study is in many ways reflective of the challenges teachers could face in implementing the NCS-FET Life Science Policy Document.

Dekkers and Maboyi (2002) conducted a study on the purpose of science teachers in doing practical work in natural science. An open-ended questionnaire was developed for this study. The research findings reveal that with regard to practical work, teacher demonstrations are the norm instead of learners' individual "hands-on" activities. While some teachers see practical work as something with its own value encompassing the manipulating of equipment, scientific methods of thought, observation etc., others see practical work merely as a means of supporting theory.

The above studies all focus **is** on maximizing the use of practical work, shifting from "cookbook" methods (procedural) to experiential learning methods and from teacher-driven demonstrations to pupil-driven practical work. They raise the following questions: Is practical work being done by learners? How effectively is practical being done by learners?

Internationally a lot of research has been done on practical work and science process skills, (Dillashaw, 1983; Arena, 1988, Goh *et al.*, 1989; Hackling & Garnett, 1995 ; Brotherton & Preece, 1996 ). These studies make reference to



how different types of learner-centred practical work promote the development of basic and integrated science process skills. Data obtained in these studies suggest that the acquiring of higher order or integrated process skills is enhanced by science programs which incorporate them explicitly. The following studies to be discussed will support my investigation on the use of practical work in the teaching of basic and integrated science process skills and show how the type of practical work done influences the types of process skills developed in learners.

Westbrook and Rogers (1994) reported that students who undertook a science course which incorporated hypothesis testing by designing and conducting experiments exhibited substantial improvement in science process skills. This study was conducted with an experimental and control class of middle school science learners who were taught the same content by the same teacher, only in different ways. In the experimental class the emphasis was on the hypothesis testing, designing and conducting experiments carried out by the learners. In the control class teacher demonstrations was the norm and only occasionally were learners allowed to conduct practicals. This study reveals that the development of process skills requires continued practice and the skills are not retained by learners if used in a brief, limited fashion. An insight that emerges from this study is that learners need multiple opportunities to develop and master process skills. They must be exposed to practical work involving hypothesis testing and

designing experiments in order to develop higher order / integrated process skills.

Staer, Goodrum and Hackling (1995) conducted a survey of 197 science teachers in 28 West Australian Schools and found that 84 % of the practical activities were of a “cookbook” nature where the problem to be examined and the investigative approach are described explicitly. Most practicals confirm principles already examined leaving little opportunity for students to develop and practice higher order and integrated skills such as those associated with the designing of experiments. According to the authors, this has deleterious effects on the acquisition of higher order process skills amongst school pupils.

A study conducted by Hackling and Ganett (1995) reveals poorly developed skills in problem analysis, planning and the carrying out controlled investigations amongst school children subjected to “cookbook” style practicals. This study indicates that there is a strong bias towards developing basic science process skills such as observing, recording and predicting, with only limited inclusion of analysis, interpretation and experimental design. These findings are similar to those of South African studies.

Brotherton and Preece (1996) investigated how practical work can be used in developing higher order / integrated science process skills in year 7, 8 and 9 classes in two small towns in the United Kingdom. This research study consisted

of an experimental and control group for each year of study i.e. year 7, 8 and 9. The experimental group was subjected to a 28 week intervention program that emphasized the development of higher order / integrated science process skills, while the control group was subjected to a program that did not emphasize the development of higher order / integrated process skills. In a post test 10 weeks after the intervention program the positive effects of the integrated process skills developed were still present as these learners could continue to conduct practical work that required knowledge of integrated process skills.

It is significant to note how the premise upon which these international studies are based differ from that of South African studies. It is taken as a given that practical work enhances learning, thus the challenge is to focus on different types of practical work done to develop certain targeted skills. In the studies done nationally, however, the emphasis is more on an attempt to understand teacher and learner practice with regard to practical work. The South African studies indicate that the opportunity for learners to do investigative work on their own is still limited and practical work is confined to using "cookbook" methods. An important feature that emerges is that the context in which practical work is done differs markedly between the local and international. In South Africa most of the practicing teachers were trained in a "content era" and it is important to take into consideration the teachers traditional view of their position and how they have constructed their practice and practical work in general. The legacy of apartheid is a major factor that continues to influence education in terms of resources,

expertise, facilities and this impacts on how practical work is done and on the types of practical work that the learner is exposed to. Contrary to countries such as Australia and England, in South Africa not all teachers teaching biology are trained as biology teachers and their knowledge of biology content is often insufficient.

The NCS-FET Life Science Policy Document has to a large extent been informed by international studies on what practical work should entail and the skills that should be developed in learners. While the NCS-FET Life Science Policy Document focuses on issues on social transformation and social justice, it does not take into consideration the injustices of the past with respect to teacher development and training. A large number of teachers teaching biology have no formal training as biology teachers. This could impact negatively on the implementation of the NCS-FET Life Science Policy Document.

## **2.4. CONCLUSION**

From the literature presented it is obvious that there is a need to change the way in which practical work is done in South Africa. Teachers in South Africa are faced with challenges in the implementation of the NCS-FET Life Science Policy Document. The next chapter describes the methodology used to answer the three critical questions of this study.

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.1. INTRODUCTION**

The open ended questionnaire and the focus group interview are used to answer the three research questions in this study. The research questions focused on teacher conception of practical work, teacher practices with regard to the types of practicals done / used and types of science process skills developed in learners.

#### **3.2. WHY THIS STUDY INVOLVES QUALITATIVE DATA**

The conceptual framework within which this study is located is sociotransformative constructivism. Within this framework the teacher is seen as a social being situated within a particular historical background. The historical background within which the teacher works is influenced by contextual factors. These factors such as resources, types of training will be considered when we examine teacher practices. Sociotransformative constructivism will be used to understand teacher practice with regard to practical work within a South African context taking into account the effects of the legacy of apartheid. The focus group interview was used to clarify and understand teacher practice with regard

to practical work. The intention is not to judge teacher practice but to understand the reasons behind teacher practices with regard to practical work.

After reading and understanding what quantitative and qualitative methodology had to offer I decided to use both methods to address the kinds of questions this study explores. The two methodologies are not seen to be opposing each other. According to Mc Kereghan(1988) they represent two ends of a continuum along which actual research takes place. Hence both methodologies are used in this study to compliment each other in obtaining data and analysis of data.

### **3.3. DEVELOPMENT OF RESEARCH INSTRUMENT**

#### **3.3.1. QUESTIONNAIRE**

Dekkers and Maboyi (2002) conducted a study that explored the purpose of teachers in doing practical work in teaching Natural Science. I recognized the merits of Dekker and Maboyi (2002) questionnaire (Appendix A) and adapted it to form an open ended questionnaire (Appendix B). This questionnaire aimed to answer the three research questions, viz.

1. What are teachers' conceptions of practical work?
2. What type of practicals do teachers claim to use to teach science process skills in the current biology syllabus?

3. Which science process skills do teachers focus to develop when using / doing practical work?

The questionnaire demonstrates content validity as it adequately covers the three research questions. An open questionnaire was used as it invites an honest and personal comment from the respondents. According to Cohen *et al.*, (2000 ) an open ended questionnaire can be used to catch the authenticity, richness, depth of response, honesty and candour which are the hallmarks of qualitative data.

#### **3.3.1.1. PILOTING THE QUESTIONNAIRE**

The questionnaire was piloted with 12 biology colleagues after school 3 months before data collection began. During the piloting session teachers were presented with the questionnaire and were asked to answer the questionnaire individually without discussion with other colleagues. The questionnaire was piloted to check the clarity of the questionnaire items, eliminate ambiguities or difficulties in working. According to Cohen *et al.*, (2000) a pilot serves to increase the reliability, validity and practicability of the questionnaire. After the question was piloted there were minor changes with the wording of one question.

### **3.3.1.2. THE MAIN STUDY**

The questionnaire was mailed to the 45 biology educators in the 24 Secondary Schools in the Phoenix area of KwaZulu-Natal. The Phoenix area of KwaZulu-Natal was chosen as I have assisted subject advisors with Grade 12 moderation of Continuous Assessment of learners and teacher portfolio files. The questionnaire was mailed to the biology teachers with a covering letter. The letter described the purpose of the study and teachers were assured of confidentiality with regard to their responses. Teachers were advised that there were no right or wrong answers to the questions but only truthful answers. Of the 45 questionnaire issued 38 were returned.

### **3.3.2. FOCUS GROUP INTERVIEW**

Data was collected in two stages. Stage one involved collecting quantitative data from the questionnaire. Prior analysis of the data from the questionnaire showed specific themes / patterns that emerged on teacher conception of practical work, teacher practice and skills developed with regard to practical work. These themes / patterns that arose needed to be explained. The focus group interview was used to seek directed explanations for the patterns / themes that arose from the prior analysis. The following questions sought to explain the themes / patterns from the prior analysis:



- What are teachers' conceptions of hands on?
- Why is there a discrepancy between our conception of practical work and our classroom practice?

According to Vaughn *et al.* (1996) the major assumption of focus groups is that with a permissive atmosphere that fosters a range of opinions a more complete and revealing understanding of the issues will be obtained. The focus group interview was videotaped, transcribed and analysed. The transcripts were analysed by means of open coding. According to Saunders (1999) open coding is a qualitative method for analyzing data in terms of themes which emerge when the data is viewed repeatedly allowing for the themes to be categorized.

The 38 teachers who returned questionnaires were invited to form part of the focus group interview that was held on a Monday afternoon. Due to a large number of teachers being involved with examinations, school duties the response rate was low. Nine teachers formed part of the focus group discussion.

### **3.4. CREDIBILITY OF DATA GATHERED**

An open ended questionnaire and a focus group interview were used to gather data on the research questions posed. The teachers were all subjected to the same questions. Data obtained from the open ended questionnaire was coded into categories and analysed quantitatively using S.P.S.S. version 11.5 for

windows. This package was used to generate frequency tables and graphs of the themes / patterns that emerged from the analysis. Themes / patterns that emerged from the data analysis were presented to the focus group during the interview to seek clarity.

#### **3.4.1. THE ANALYSIS OF CRITICAL QUESTION ONE**

Based on teacher responses to two questions in the questionnaire viz. A1 and B1 (see appendix B) categories that describe teacher's conception of practical work were established. From these categories frequency tables (appendix C) were drawn up. It was imperative to establish the frequency of the categories that were prevalent. The following six categories of teacher conception on practical work were generated:

- Hands on approach;
- Guided investigation;
- Reinforcement of theory;
- Team work;
- Relating theory to practice;
- Participation by learners.

### **3.4.2. THE ANALYSIS OF CRITICAL QUESTION TWO**

From the teachers' responses to questions A.4.1 and B4 in the questionnaire (Appendix B), categories for the types of practical work teachers use were formed. Frequency tables (Appendix C) were generated from these categories. It was necessary to determine the frequency of the categories that prevailed. Seven categories for the types of practical work teachers use were formed.

- Demonstrations;
- Guided investigations;
- Group work;
- Diapositives;
- Transparency / model / torso;
- Dissection;
- Microscope work.

### **3.4.3. ANALYSIS OF CRITICAL QUESTION THREE**

Responses given by teachers to questions A 3.2, A 4.3 and B 4 of the questionnaire were used to generate categories on the science process skills developed in learners. The categories were used to generate frequency tables to see which science process skills teachers developed in learners. The following seven categories were generated:

- Recording of data;
- Observation;
- Developing critical thinking;
- Drawing / plotting of graphs;
- Tolerate others views;
- Team work;
- Investigative skills.

### **3.5 CONCLUSION**

Chapter two and three set out the conceptual and methodological framework for this study and laid the foundation for the presentation of results. Chapter four will provide results obtained from two data sources viz. the questionnaire and focus group interview.

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

#### **4.1. INTRODUCTION**

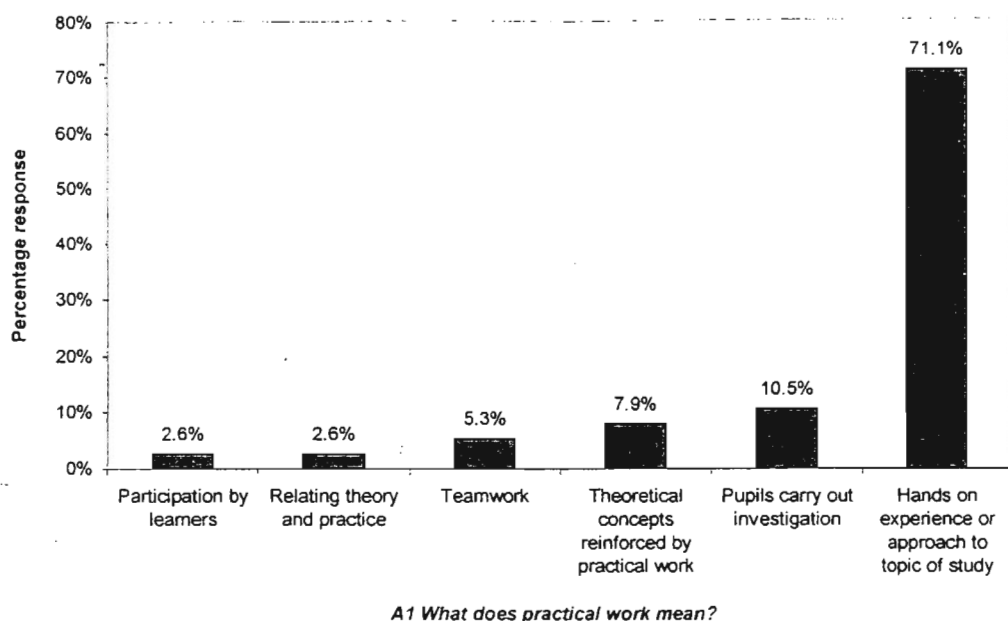
This chapter presents the results of the data gathered to answer the three critical questions of this study. During the presentation of the results, each critical question will be answered by referring to the two data sources, namely, the open ended questionnaire and the focus group interview.

#### **4.2. CRITICAL QUESTION ONE: WHAT ARE TEACHERS CONCEPTIONS OF PRACTICAL WORK?**

Data obtained from the open ended questionnaire indicate the following conceptions of practical work, which may be associated with:

- Hands on activity;
- Guided investigation;
- Reinforcement of theory;
- Team work;
- Participation by learners;
- Relating theory to practice.

**Figure 1: Teachers' conceptions of practical work**



It is interesting to note that in the figure above 71.1 % of the teachers conceive practical work to include hands on activities. It appears that teachers' conception of practical work does not include participation by learners and investigations carried out by learners. As illustrated in the graph above (Fig. 1) only 10.5 % and 2.6 % associated practical work with investigation and participation by learners. If teachers' conception of practical work was indeed inclusive of investigation and participation by learners then we would have expected these percentages to be closer to 71.1 %. This discrepant observation as presented by the data was significant; hence it needed further elaboration and justification by the teachers themselves.

In this regard, the focus group interview served to probe, amongst other things, teachers' conception of "hands on activities". During the focus group interview the discrepant observation from the data obtained from the questionnaire, was presented to the teachers. What is significant is that teachers' conception of "hands on" could be reduced to a single descriptor, namely, manipulation of apparatus. I draw on the following excerpts to highlight this point:

*T1 ... "handling of apparatus by pupils..."*

*T6 ... "manipulation of apparatus by pupils themselves..."*

From the excerpts above, it is evident that teachers see "hands on activities" as involving the manipulation of apparatus. Teachers do not see "hands on activities" to extend beyond the handling of apparatus. Skills such as inquiry based learning, critical and creative thinking, problem solving or designing experiments are not embraced in their conceptions of hands on. Data presented in the focus group interview illustrates that teachers' conception of "hands on" is, in fact, congruent with their conception of practical work. Teachers' conception of practical work entails "hands on activity", guided investigation, team work and participation by learners. When we look at these four categories we see that it involves the handling of apparatus by learners. Teachers' conception of practical work is therefore in accordance with their conception of practical work.

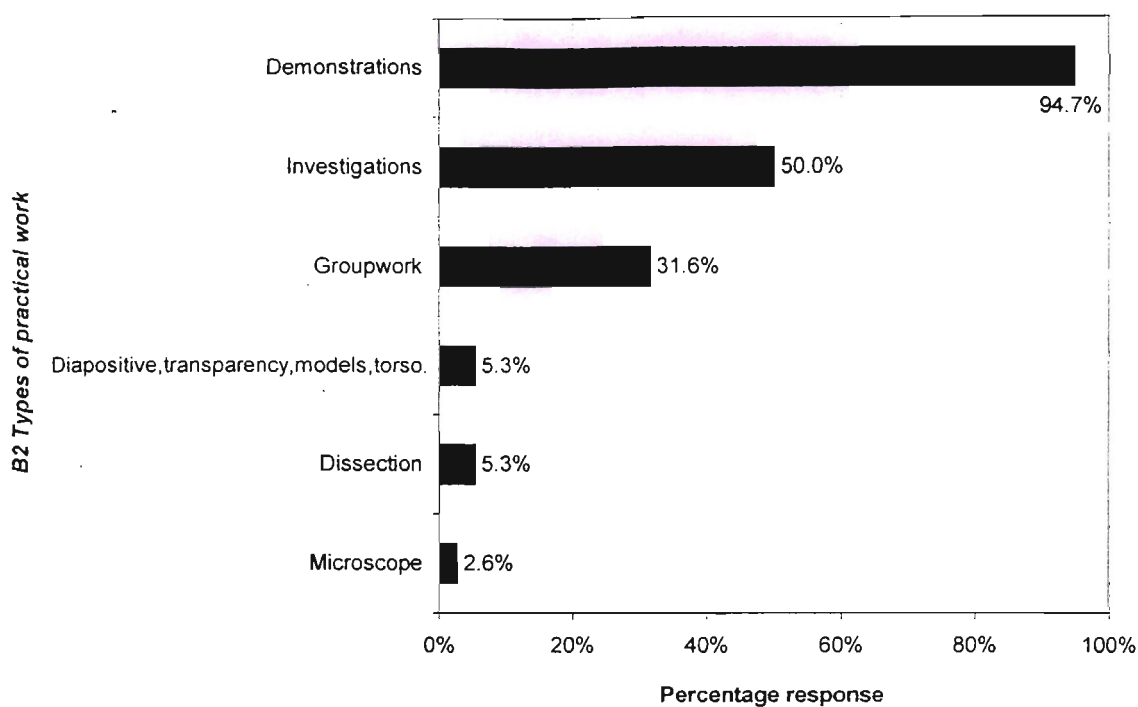
#### **4.3. CRITICAL QUESTION TWO: WHAT TYPE OF PRACTICALS DO TEACHERS CLAIM TO USE TO TEACH SCIENCE PROCESS SKILLS IN THE CURRENT BIOLOGY SYLLABUS?**

From the data gathered using the open ended questionnaire it was evident that teachers use the following ways to do practical work:

- Demonstrations;
- Guided investigations ( cookbook method);
- Group work;
- Diapositives;
- Transparency /model / torso;
- Dissection;
- Microscope work.

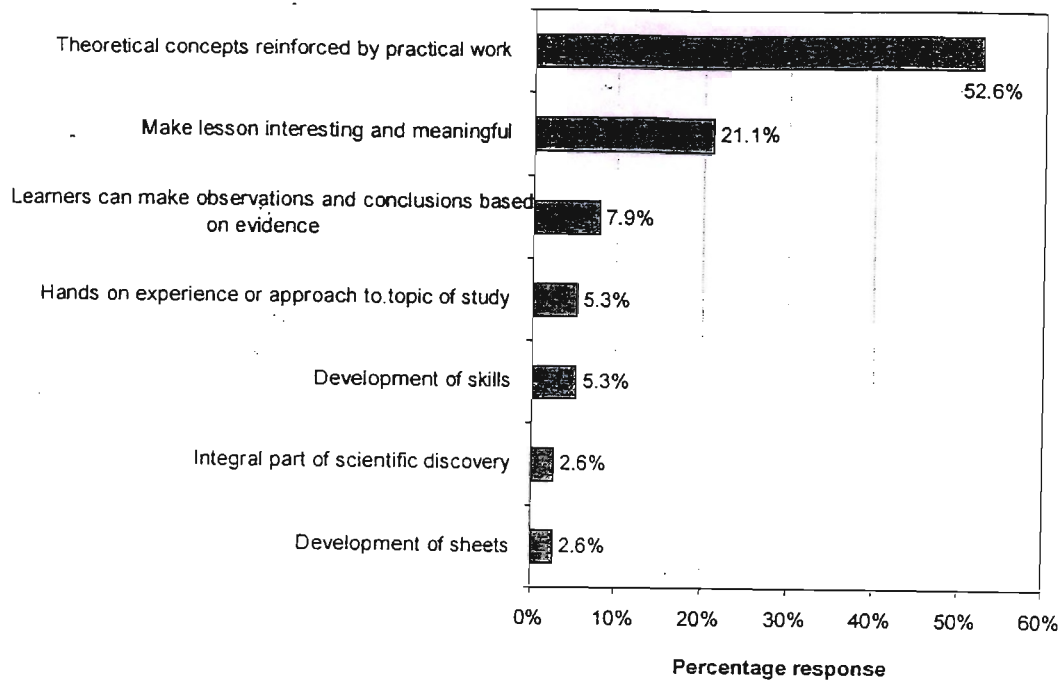


**Figure 2: Types of practical teachers use to teach science process skills**



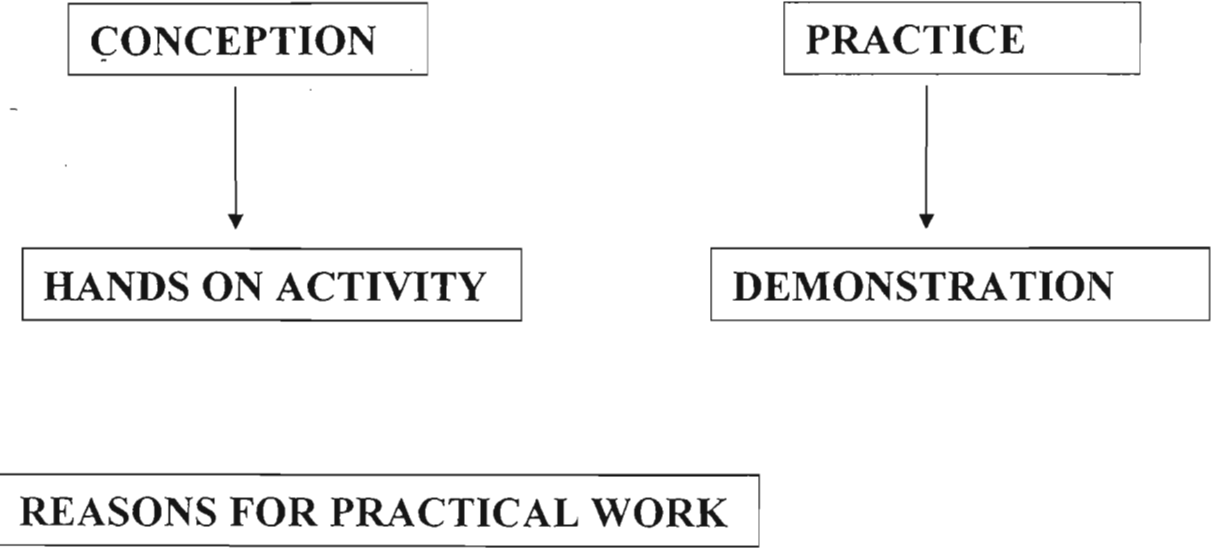
What is worth noting in Figure 2 is that 94.7 % of the teachers use demonstrations as the main way of doing practical work. A variety of reasons were cited by teachers, in the open ended questionnaire for using this particular method of doing practical work as illustrated in Figure 3 below.

**Figure 3: Reasons for using particular methods of doing practical work**



We illustrated in research question one that teachers' conception of practical work was congruent to "hands-on activity". In the results obtained for the second research question we notice a huge disparity. While teachers' conception of practical work involves "hands on activities" in their actual classroom practice, 94.7 % of them use demonstrations. For example, in the first research question the impression was created that 71.1 % of the teachers engage learners in "hands on activities", but in Figure 3 only 5.3 % of them use " hands-on activities". This disparity between teachers' conception of practical work and types of practical used, e. g., demonstrations, was brought to the teachers' attention during the focus group discussion.

**Figure 4: Model of teacher conceptions vs. actual practice**



**Reinforce theory (52,6%)**

**Make lesson more interesting and meaningful (21,1%)**

**Make observations and Conclusions (7,9%)**

**Development of skills (7,9%)**

**Integral part of scientific discovery (2,6%)**

Teachers responded to this information by explaining why they use demonstrations as a way of doing practical work. They cited the following reasons for using demonstration. Excerpts from the focus group discussion (Appendix D) are used to highlight the conditions under which teachers work.

- Large classes

*T1 ..... "I really find that it's a problem to work with 40 or 50 plus in a class "*

*T6 ..... "Control is a problem ... in terms of large classes."*

- Lack of Resources

*T2 ..... "Financial restraints ..... lack of resources... chemicals will have to be replaced"*

- Syllabus coverage

*T8 ... " Syllabus coverage ... time... "*

- Time constraints

*T1 : "... time is a factor ... cannot set up apparatus, get results in one period..."*

- Lack of laboratory assistance

*T7: "... large number of pupils ... we do not have assistance.."*

- Demonstrations yield quick,easy,correct results.

*T3: "... demonstrations are easy, quick and correct results...are... this is what's going to happen..."*

- Assessments

*T3 : " ... The method of assessments ... Its basically test... OBE framework...has other methods of assessment...only in the assignment its different..."*

- Lack of teacher preparedness

*T3 : "... People are afraid to do the practicals ... lots of the teachers themselves can't do these practicals..."*

*T6 : "... I don't think those two days of training was sufficient..."*

*T3 : "... We need training ... sustained long term training..."*

What emerged from the focus group interview was that teachers justified their use of demonstrations as a method of doing practical work. Teachers' justification of the method used, i.e. demonstrations, involved content and contextual factors. Examples of content factors are syllabus coverage, assessment while examples of contextual factors include lack of resources, large classes, and lack of laboratory assistance etc. What these results tell us is that contextual factors play a significant role in determining teacher practice. For example the following excerpts illustrate how contextual factors dictate teacher practice:

*T3 : “... teachers themselves can’t do these practicals...” they try their best ... but you need basic resources ... we need training...”*

Contextual factors continue to impact on teacher practice and in this regard teacher conception of practical work is limited. Teacher practice remains confined to manipulation of apparatus and demonstrations instead of inquiry based learning, critical and creative thinking, problem solving and designing experiments as envisaged in the NCS-FET Life Science Policy Document (DoE, 2003). This study confirms the research findings of Dekker and Maboyi (2002) that shows with regard to practical work teacher demonstrations are the norm instead of learners’ individual work.

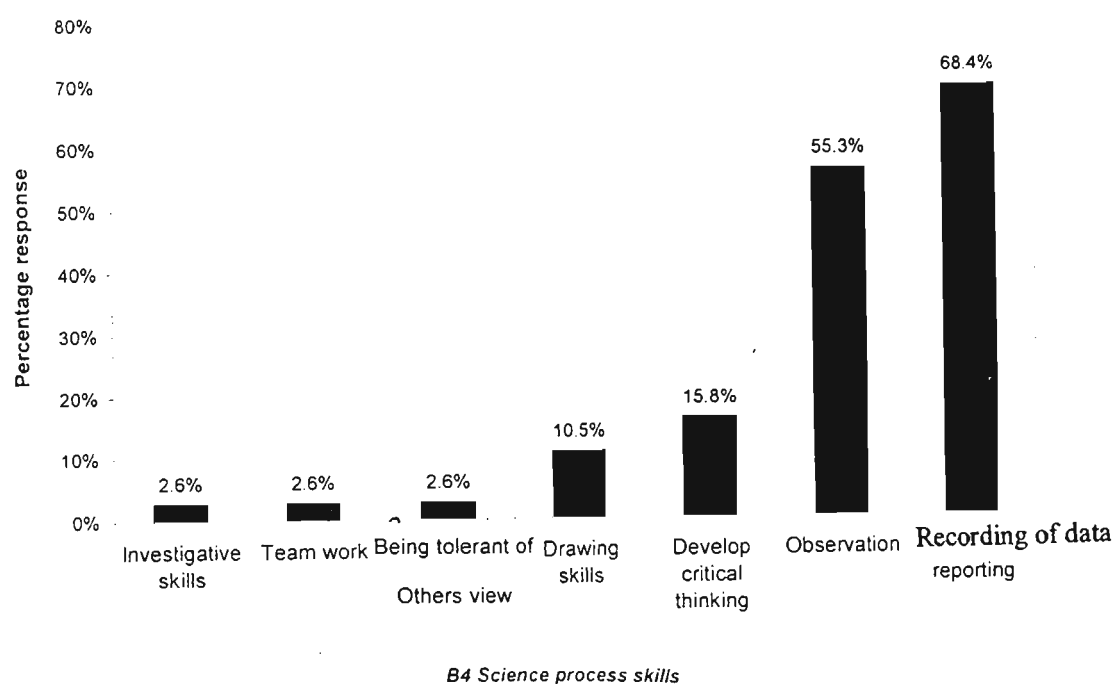
#### **4.4. CRITICAL QUESTION THREE: WHICH SCIENCE PROCESS SKILLS DO TEACHERS FOCUS TO DEVELOP WHEN DOING PRACTICAL WORK?**

Results from the second research question indicated that demonstrations and cookbook methods are the main types of practical work used. In relation to practical work teachers develop the following science process skills in learners viz.

- Recording of data;
- Observations;
- Developing critical thinking;

- Drawing skills;
- Being tolerant of the views of others;
- Team work;
- Investigative skills.

**Figure 5: Science process skills developed in learners**



Science process skills entail both basic and integrated process skills. Basic science process skills includes observing, inferring, measuring, recording information, classifying and predicting while integrated science process skills involves controlling variables, defining operationally, hypothesizing, interpreting data, formulating models, designing experiments.

The results of this study indicate that the type of science process skills developed in learners is skewed towards the development of basic science process skills. For example, more than 50% of the teachers focus on recording of data and observation which are regarded as basic science process skills. Less than 20% of the teachers focus on the development of critical thinking while only a small percentage of the teacher focus on the development of investigative skills.

These findings should be viewed against the backdrop of the research of Staer et al. (1995), discussed earlier.

#### **4.5. SUMMARY OF FINDINGS**

Teachers perceive practical work to involve “hand on” activities. For teachers “hands-on” activities are limited to the manipulation of apparatus. Their conception does not include activities that involve inquiry based learning, critical and creative thinking, problem solving and designing experiments. During their actual classroom practice teachers rely heavily on demonstrations. Teachers’ conception of practical work is therefore not congruent to their actual practice. Teachers cited content and contextual factors that impacted and influenced their actual classroom practice. Based on teachers’ classroom practice, the skills developed in learners strongly lean towards the development of basic science process skills.



#### **4.6. CONCLUSION**

This study aims to illuminate teacher practice with regard to practical work within a South African context. The conceptual framework within which this study is located is sociotransformative constructivism. The teacher is seen as a social being situated within a particular historical background. In understanding the teacher practices, we take into account the contextual factors that influence their practice. The content and contextual factors that influence teacher practice with regard to practical work will be discussed further in Chapter Five

## **CHAPTER 5**

### **5.1. INTRODUCTION**

The data obtained from the open ended questionnaire and focus group interview reveal certain interesting patterns. In this chapter I conclude this study by discussing these patterns that emerged. The discussion also highlights the challenges facing teachers in light of the NCS-FET Life Science Policy Document. Finally, recommendations are made based on the research findings and the implications for curriculum developers, subject advisors and teacher training centers are noted.

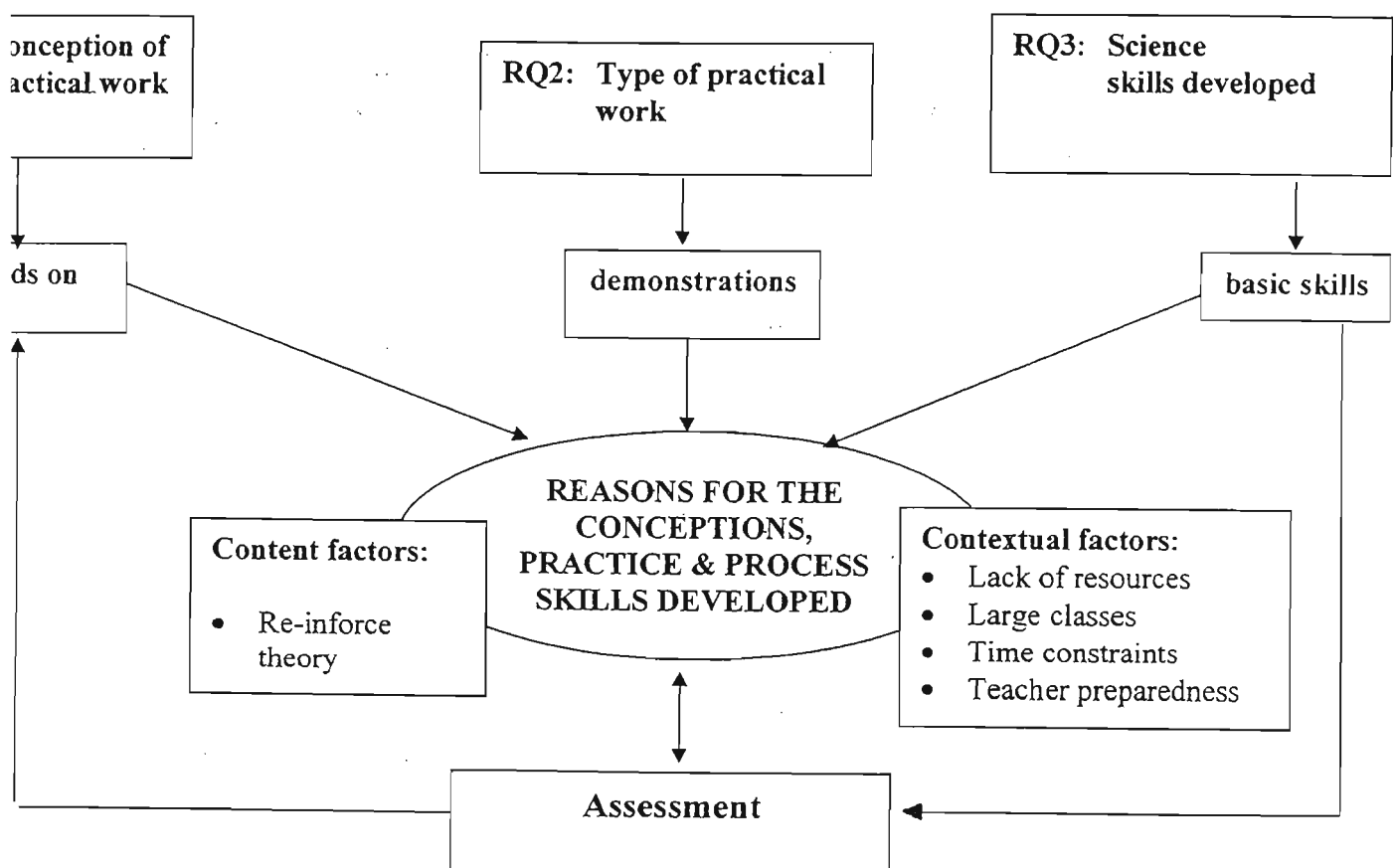
### **5.2. DISCUSSION ON PATTERNS THAT EMERGED**

This study focused on Senior Secondary Biology teachers, their conception of practical work, their practice with regard to the type of practical work done and science process skills they seek to develop in learners during practical work. In this regard, this study has paid particular attention to the impact of that both content and contextual factors have on these three issues.

From the data obtained for the three research questions a "webbed" pattern seems to be emerging amongst teacher conception of practical work, teacher practice, science process skills and assessment criteria. This webbed pattern

has strands with respect to teacher conception, teacher practice and science process skills that could be perceived as isolated, but they are in a way “drawn together” by another “force”, and this force is assessment. What is worth noting in the figure below is the salient but almost “imperceptible webbing” influence that assessment (exam) requirement has on teacher practice; science process skills they focus on and teacher conception with regard to practical work.

**Figure 6: Diagrammatic representation of how teachers’ conceptions practice and process skills focused upon relate to assessment**



T050186

The above figure shows that with regard to research question one teachers conceive of practical work as a “hands-on” activity where learners manipulate apparatus. With respect to research question two, the above figure depicts that teachers use demonstrations as the main method of doing practical work. In relation to research question three, the above diagram reveals that the science process skills teachers focus on during practical work are basic science process skills, namely, observation; recording of data, measuring and drawing.

Let us now turn to a discussion of this webbed pattern existing amongst teacher conception of practical work, teacher practice during practical work, science process skills and assessments. This was an unexpected finding. It did not emerge from the data obtained via the open-ended questionnaire. If it were not for the focus group interview, we would not have been able to explore the impact of assessment on teacher practice. The focus group interview was dominated by what teachers perceived to be the limited prescribed assessment methods.

Teachers defined their role in terms of what is expected of them, namely to meet the assessment requirements as stipulated by the Biology Continuous Assessment Policy Document. The subject advisors see to it that teachers adhere to these stipulations set out by the Biology Continuous Assessment Policy Document. There is little room left for teachers to think creatively about methods of assessment. In consequence, traditional content based tests drive the process of assessment and determine what teachers do. To a large extent these tests only cover basic science skills. Learners are not exposed to other

methods of testing as stipulated in the OBE / FET/ Learner-centered framework. This lack of exposure to other methods of assessment was voiced strongly during the focus group interview.

Teachers in all schools are expected to maintain consistency, i.e. cover the same sections of the syllabus with similar tests. This results in teachers feeling disempowered to explore other methods of testing. Teachers' perceptions of their role, on the one hand, and what is expected of them on the other, lead to assessment weaving itself into teacher practice. This "weaving" was characterized by teachers feeling pressurized to complete these assessment requirements within a set period of time. As a result, time available to engage learners in "hands-on" activities becomes limited. This leads teachers to resort to demonstrations targeting specifically skills that the learner is expected to know with regard to a assessment requirement. The outcome of learning in this situation is limited for both teachers and learners. There are no opportunities for teachers to explore new methods of assessments, doing practical work or giving learners the opportunity to discover new ways of learning and developing integrated science process skills. The role of the teacher remains confined to that of being on "imparter" of knowledge.

Thus far assessment requirements have been linked to teacher practice and science process skills developed in learners. Assessment has, however, weaved itself into how teachers conceive practical work. When teachers were asked to

describe in their own words what practical work means to them, they described it as “hands on” activity. But when asked to describe practical work in terms of their practice they see it as the manipulation of apparatus. This depicts how assessment comes to the fore in teacher practice and how teachers conceive practical work in the light of assessment requirements. Teachers do not conceive practical work to include inquiry based learning, problem solving, critical and creative thinking and designing experiments. Due to the “webbing influence” of assessment requirements, practical work is not as it should be - a platform for developing integrated science process skills.

### **5.3. CHALLENGES FACING TEACHERS IN ESPOUSING THE NCS-FET LIFE SCIENCE POLICY DOCUMENT**

Although teachers practice and science process skills developed in learners partially espouses the philosophy of the NCS-FET Life Science Policy Document we need to look at how practical work is conceived and conducted within the South African context. We need to acknowledge our unique socio/political/historical background. It is important for us to see teachers as social beings who are situated within a particular historical background. The historical background within which teachers work is influenced by contextual factors. According to the Integrated Quality Management System policy document (DoE, 2003), contextual factors are factors that influence the teachers practice within a learning environment and that these factors are beyond the

control of the teachers. Examples of contextual factors in this study include lack of resources, lack of laboratory assistants and limited teacher preparedness and limited methods of assessment. I see these contextual factors as challenges teachers face in embracing the philosophy of the NCS-FET Life Science Policy Document.

With respect to resources the prevailing inequitable distribution of textbooks, apparatus, chemicals, models, and finances impacts on teaching as well as learning. We must recognize the fact that teachers try to improvise and use whatever local resources they have access to. However, certain basic requirements must be met before teachers can create and sustain a learning environment that is conducive to learner-centredness and the development of integrated science process skills. If these basic requirements with regard to resources are not met then teachers are forced to continue with their role as “imparters” of knowledge. Large classes, time constraints and lack of laboratory assistants influenced teachers to use demonstrations as a way of doing practical work. Teachers do not have sufficient apparatus/resources for each learner to engage in individual practical work. If each learner were to engage in “hands-on” activities, this would invariably impact on the time available for syllabus coverage and on the teachers’ ability to meet the numerous assessment requirements. Added to this, the lack of laboratory assistants means that it becomes impossible for the teacher to conduct authentic laboratory assessment work in these large classes. This lack of laboratory assistant also has implications for the

development of integrated science process skills as well as the facilitation of learning.

With regard to teacher preparedness we must allude to the fact that many of our practicing teachers were trained in a content based paradigm, in which the focus of attention was syllabus coverage and preparing learners to excel in examinations. In a content based curriculum little or no attention was devoted to the development of integrated science process skills. These teachers are experts in a content based curriculum and are now expected to function in a learner centred environment with an OBE curriculum with minimum amount of training and support.

The role of the teacher has now changed from “impartor” of knowledge to that of facilitator. Teachers are aware that the role of facilitator comes with new responsibilities. What came to the fore during the focus group interview is the overwhelming outcry by teachers for proper and effective retraining. Teachers felt that this would enable them to effectively operate within a learner-centred teaching environment so as to espouse the philosophy of the NCS-FET Life Science Policy Document.



## **5.4. RECOMMENDATIONS**

The successful implementation of the NCS-FET Life Science Policy Document depends on teachers. Teachers will be responsible for fulfilling the expectations of this document in their classroom. In an attempt to improve the quality of science education in South Africa, the focus of the NCS-FET statement is limited to the development of the curriculum while the details of how it will be implemented at a school level is neglected. Although the sample size of the focus group was relatively small, recommendations could be made on the following issues: sustainable teacher development / support and innovative assessment methods. I elaborate on these issues under teacher professional development.

### **5.4.1. TEACHER PROFESSIONAL DEVELOPMENT**

Sustainable teacher development / support is required so that teachers can successfully make the transition from being dispensers / imparters of knowledge to being facilitators. Training courses must be more in-depth, over a longer period of time. They should be conducted by “facilitators” who are more than knowledgeable and “aufait” with the requirements of the NCS-FET Life Science Policy Document and are fully aware of the challenges facing teachers in creating a learner-centred environment.

Short development programmes must take place on a regular basis to provide support and encouragement to the teachers to ensure the facilitation of a learner centered environment. Our practice needs to extend beyond demonstrations. Teachers need to be exposed to a variety of teaching styles.

Our present method of assessment needs revisiting. Training in innovative methods of assessment is required. The findings of the study show that if we have creative ways of assessment, current teacher practice will in all probability become more creative. Training in innovative methods of assessment will engage learners in integrated science process skills and lead to the development of inquiry based learning, problem solving, critical and creative thinking as well as experimental design. Assessment methods will extend beyond the classroom. In this regard more support material for teachers in terms of good exemplars of good practice which will encourage the development of integrated science process skills should be developed. Teachers desperately need to be shown how to engage learners in these types of activities. Teachers need first hand experience on how to create and sustain a learner-centred environment.

## **5.5. IMPLICATIONS OF THIS STUDY**

This study has implications for policy makers, curriculum development unit, subject advisors and teacher training centres. As far as policy makers are concerned, this study has shown how they concentrate on the development of

curricular to the detriment of the implementation of these curricula at school level. Policy makers also need to be cognizant of the time frame within which they hope the policy document will be implemented. They need to must liaise with the curriculum development units to retrain teachers accordingly before the implementation date of the policy. The curriculum development unit needs to provide to existing teachers sustainable teacher development on a continuous basis so that teachers can create and maintain an effective learner-centred environment. Subject advisors need to assist teachers in revisiting present method of assessment and make greater inputs to policy maker about the need to change methods of assessment. With regard to teacher training centres, these need to ensure that trainee teachers are exposed to varied methods of teaching and assessment so they can truly create a learner-centred environment.

## **5.6. CONCLUSION**

The conceptual framework used in this study, i.e. sociotransformative constructivism, allows us to explore the relationship amongst assessment, teacher practice, teacher conception and science process skills developed during practical work. In this study, assessment comes across as a major factor that influence teacher practice, teacher conception and science process skills focused on with regard to practical work. This implies that we seriously need to rethink our method of assessment. Studies by Westbrook and Rogers (1994), Staer *et al.* (1995) and Hackling and Garnett (1995) show how the type of

practical work done influences the types of science process skills developed. While this study reveals that assessment is a limiting factor on teacher conception, teacher practice and science process skills focused on with regard to practical work, assessment can be used creatively to create a learner-centred environment that encourages the development of integrated science process skills.

There is a need for teachers to change their practice in order to espouse the NCS-FET life science policy document philosophy. Until we disengaged from our present method of assessment, teachers will forever remain caught in a vicious cycle, where they cannot “think creatively” about what they do. This stereotype method of assessment will continue to impact on our conception and practice with regard to practical work, until there is a major change in assessment methods. It is only then that we will be able to change our practice and reconceptualize the way in which we create an effective learning environment.

The webbed influence that assessment has on teacher conception, teacher practice and science process skills focused on with regard to practical work extends, in fact, beyond the realms of the teacher. Active intervention, support and guidance are required from curriculum developers, policy maker and subject advisors. There is an urgent need to revisit the assessment methods used and to come up with guidelines that are prescriptive but that allows for flexibility and

varying teaching strategies. This will foster the development of integrated science process skills.

---

## Appendix

## Appendix A

### Appendix: Questionnaire: Teacher's purposes for doing practical work in the teaching of natural Sciences

This questionnaire has been designed to explore your purposes for doing practical work in the teaching of natural sciences. The results of this survey are expected to have a positive impact on the ACE programme. Please note that your names will remain anonymous and the information that you'll provide will be treated as confidential. Kindly fill in the information required as it forms part of the study

Sex (put a cross)	Female	Male
Age		
Professional teaching qualification(s)		
Highest academic qualification (e.g. less than std 10, std 10, 1st year university, 2nd year university, BA etc)		
Teaching experience in Science (in years)		
Science subject(s) you are currently teaching and the respective grades		

Please answer the following questions with regard to practical work.

Can you describe in your own words what practical work means to you?

Do you ever conduct practical work?

How often do you carry out practical work in grades 7 – 9 (or the grades in which you teach)?

When did you last do practical work in grade 9 (or the grade that you teach)? What was it about?

If you do not conduct practical work do you use activities that are similar to practical work when teaching?

If so, can you give examples of such activities?

Why these activities instead of practical work?

If you never do practical work, and only similar activities, answer questions 11-15

Do you like doing practical work? Please explain.

What do you like about it?

What do you dislike about it?

Why do you include practical work in your teaching?

Do your learners learn something from practical work?

Can you give examples of the things they learn?

How can you be sure that they learn this from doing practical work?

How do you assess practical work?

How do you organize practical work?

How do you prepare learners for practical work?

What instructions do you give learners during practical work?

How do you avoid that learners create a mess during practical work?

What, in your view are the most important problems when doing practical work?

If you use practical work in teaching and learning, you do not have to answer questions 11-15

Do you like activities similar to practical work? Please explain

What do you like about the activities?

Why do you include activities similar to practical work in your teaching?

Do your learners learn something from those activities similar to practical work?

Can you give examples of the things they learn?

How can you be sure that they learn this from the activities?

How do you assess those activities?

How do you organize those activities similar to practical work?

How do you prepare learners for those activities?

What instructions do you give learners during those activities?

How do you avoid that learners create a mess during those activities?

What, in your view are the most important problems when doing the activities similar to practical work?

## Appendix B

Dear Science Colleagues

Thank you for participating in the survey , for taking the time and making the effort to answer this questionnaire . This survey is conducted to investigate the use of practical work in the teaching of science process skills at Secondary Schools .

The information gathered from this survey will be used for my study purpose and NOT for the department records . You are assured of total confidentiality . Please note there are no wrong answers to these questions but only truthful answers .

Thank-you for your co-operation .

Yours in Science

Ashe Pillay

C / o Havenpark Secondary School

031 – 50551495

Cell Number :

084 430 3795



### Section A

1. Can you describe in your own words what practical work means to you ?

---

---

---

---

2. Why do you include practical work in your teaching ?

---

---

---

---

3.1 Do your learners learn any science skills from practical work ?

---

---

---

3.2 Can you give examples of the science skills they learn ?

1 

---

2 

---

3 

---

4 

---

5 

---

6 

---

---

---

3.3 How can you be sure that they learn this from doing practical work ?

---

---

---

---

---

4.1 Do you use different types / forms of practical work in your teaching ? If so state the types / forms of practical work used in your teaching .

1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_  
5 \_\_\_\_\_  
6 \_\_\_\_\_

4.2 What instructions do you give learners during practical work ?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4.3 Which science skills do you focus on , to develop in learners during practical work ?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### Section B

1. In your opinion what are the goals / aims of doing practical work in the teaching of biology ?

---

---

---

---

2. What forms / types of practical work ( eg. demonstrates , closed investigations ) do you use in teaching the current biology syllabus ?

---

---

---

---

3. Do you design a worksheet for every practical ? If so what type of information is included in the worksheet ( eg. Aim / Procedure )

---

---

---

---

4. Which science process skills do you focus on or plan to develop in learners during practical work using the current biology syllabus ?

---

---

---

---

5. In the RNC document the term process skills is commonly used . What is your understanding of the term " process skill " ?

---

---

---

Thank you for your participation .

## Appendix C

**A1**

	Frequency	Percent
Hands on experience or approach to topic of study	27	71.1
Participation by learners	1	2.6
Pupils carry out investigation	4	10.5
Relating theory and practice	1	2.6
Teamwork	2	5.3
Theoretical concepts reinforced by practical work	3	7.9
Total	38	100.0

**A2**

	Frequency	Percent
Development of critical thinking	1	2.6
Development of skills	2	5.3
Hands on experience or approach to topic of study	2	5.3
Integral part of scientific discovery	1	2.6
Learners can make observations and conclude based on evidence	3	7.9
Make lesson interesting and meaningful	8	21.1
Theoretical concepts reinforced by practical work	20	52.6
Total	38	100.0

**A3.1**

	Frequency	Percent
No response	1	2.6
Yes	37	97.4
Total	38	100.0

	Frequency	Percent
A3.2.1 Observation	26	68.4%
A3.2.2 Recording data	19	50.0%
A3.2.3 Analysis of data, Interpretation & Deductions	29	76.3%
A3.2.4 Measurement	12	31.6%
A3.2.5 Scientific thinking, scientific skills	4	10.5%
A3.2.6 Life skills	3	7.9%
A3.2.7 Setting up & handling of apparatus	13	34.2%
A3.2.8 Drawing/plotting graphs	11	28.9%

### A3.3

	Frequency	Percent
Assessments, Tests	26	68.4
Cannot be measured	1	2.6
Children learn better by doing	1	2.6
Feedback from pupils	3	7.9
No other theoretical activity can develop these skills	1	2.6
Perform practical work on their own	1	2.6
Pupil's can draw from experience	1	2.6
Skills emphasised during practical work	2	5.3
Understand concepts at end of lesson	2	5.3
Total	38	100.0

	Frequency	Percent
A4.3.1 Critical thinking	7	18.4%
A4.3.2 Make observation & draw conclusion	14	36.8%
Observation	2	5.3%
A4.3.3 Correct attitude	2	5.3%
A4.3.4 Appreciate nature	1	2.6%
A4.3.5 Drawing	6	15.8%
A4.3.6 Recording & analysis of data	26	68.4%
A4.3.7 Safety	3	7.9%
A4.3.8 Teamwork	2	5.3%

	Frequency	Percent
A4.1.1 Demonstration	27	71.1%
A4.1.2 Observation	13	34.2%
A4.1.3 Use of equipment, Microscope	12	31.6%
A4.1.4 Diagrams, models, charts, videos	9	23.7%
A4.1.5 Drawing	1	2.6%
Hands on work	19	50.0%
A4.1.6 Dissecting	1	2.6%
Recording data	3	7.9%

	Frequency	Percent
A4.2.1 Clean apparatus	1	2.6%
Obey lab rules	6	15.8%
Observe	1	2.6%
Work scientifically	2	5.3%
A4.2.2 Safety & Precautions	14	36.8%
A4.2.3 Teamwork	6	15.8%
A4.2.4 Record all results accurately	11	28.9%
A4.2.5 Guidelines & Instructions	23	60.5%

**B5**

	Frequency	Percent
No response	5	13.2
Ability to do something	1	2.6
Ability to investigate & draw conclusions	6	15.8
Develop skills in practicals	11	28.9
Don't know	3	7.9
How a process works	3	7.9
Improve manipulative & mental concepts in order to investigate	2	5.3
Not sure	1	2.6
Scientific skills	1	2.6
Skills that pupils are expected to learn	3	7.9
Survival skills	1	2.6
Thinking skills	1	2.6
Total	38	100.0

		Frequency	Percent
B1	Develop logical & critical thinking	7	18.4%
B1.1	Enhance learning, Reinforce theory	26	68.4%
B1.2	Develop practical skills	1	2.6%
	scientific thinking	10	26.3%
B1.3	Stimulate interest	5	13.2%
B1.4	Hands on experience	6	15.8%

		Frequency	Percent
B2.1	Demonstrations	36	94.7%
B2.2	Investigations - guided	19	50.0%
B2.3	Dissection	2	5.3%
B2.4	Groupwork	12	31.6%
B2.5	Microscope	1	2.6%
B2.6	Diapositive, transparency, models, torso	2	5.3%

		Frequency	Percent
B3.1	No response	3	7.9%
	N	15	39.5%
	Y	20	52.6%
B3.2	Aim, apparatus reqd, procedure, observation, conclusion	26	68.4%
	Worksheet available in workbook	6	15.8%

		Frequency	Percent
B4.1	Develop critical thinking	6	15.8%
B4.2	Investigative skills	1	2.6%
	Team work	1	2.6%
B4.3	Tolerate other views	1	2.6%
B4.4	Recording of data	26	68.4%
B4.5	Observation	21	55.3%
B4.6	Drawing skills	4	10.5%

## TRANSCRIPTS OF FOCUS GROUP INTERVIEW – APPENDIX D

: Good Afternoon colleagues I'd like to thank you for making time for this presentation and the focus group discussion that will pursue. Not so long ago you received a questionnaire from me that focused on teachers' conception of practical work, types of practical work teachers use to teach science process skills the science process skills teachers develop. What I'm going to do today is share the data obtained from analysis of the questionnaire. At the outset I'd like to inform you that the framework within which I led this study allows for social, historical and contextual factors to be taken into account when looking at themes / patterns that arise from the data. What is interesting is teachers' conception of practical work arises from the data. A vast majority of teachers 71,1 % indicated that practical work involves a hands on activity. At this point this conception of hands on is congruent to the NCS-FET Life Science Document which is based on learner - centred, inquiry based learning, developing high skills and knowledge, critical thinking, identifying problems, solving and design. Our conception of practical work is in keeping with, it is congruent with the philosophy document at this point I'd like some clarity on what hands on activity means to the teachers. If we could just get some clarity on hands on ...

Hands on basically means working with apparatus, it is not a demonstration, each pupil is doing the



: Each pupil handles the apparatus themselves

: T 3 would you like to add to that.

: I think that they have er...

: Covered it

: Pupils manipulate the apparatus

: Basically hands on involves getting more practical exposure and use of apparatus with the ultimate of developing dexterity at the same time the learner is able to draw inferences and conclusions himself based on work done in the lab by themselves.

: So our conception of hands on involves manipulation of apparatus by learners. Another interesting e that emerged from the data or pattern that emerged from the data is that teacher practice involves onstrations, our conception which is in keeping with the NCS-FET policy document philosophy is not ruent to our practice. In practice in our classroom a vast majority 71,1 % of us are using

demonstrations perhaps we could elaborate why we use demonstrations, why we rely so largely on demonstrations as the main method of practical work.

: We have very large classes and as a result it is difficult for us to get each child to have his own private set of resources. Control is a problem as well in terms of the large classes that is why many of us including myself rely on demonstrations as a method.

: Also time is a problem, we won't be able to set up apparatus, get results in the short time. Time is a straint.

: Another factor to consider as well at school, with regards to financial constraints is resources. To give every pupil the chemical by the end of the year we have to replace all the chemicals. In terms of large numbers and the amount of financial constraints at school we resort to this teacher practice.

: In terms of large number of pupils we have, we do not have assistants for the teachers in the classroom.

: Yes, we basically lack lab assistants in schools and this impacts on our practice, as well as lack of resources, availability of time etc.

: Syllabus coverage

: Syllabus coverage , yes, any other factors that could .....

Could I just add while we hear what teachers go through, as teachers in the classroom we know there are many constraints, also a reason for going on to this cookbook method is, could be, that people are reluctant to do the practicals, when you do the demonstration there is an easy result, correct result, you tell them this is what's going to happen , when you set up experiments in the lab in lab conditions not always do we get results, desired results, so lots of the time while time is the factor I notice that in plant relations a lot of the teachers themselves can't do these practicals so its easy to do the demonstration over and over ... for example setting the potometer underwater how many of our colleagues fail to do that, now what I'm saying so there are other reasons why sometimes people don't do the practicals.

You think this could be related to the kind of training we had.

Yes in fact you hit it right on the head. It's got to do with the training. We need training. For example we've been doing training and courses where people are getting 2 or 3 day training course where we spent

3 hours trying to show how this new system, this new syllabus works to teachers. What you need is  
ained long term training and courses to help.

: so it is also related to the training we have, T6 you want to say something about the training we have.

: With regards to the OBE Curriculum I am disappointed in the sense that I had to go on this training  
ng my holiday and I would say that years of training were all encompassed within two days, just  
pacted within 2 days. Most of the information was difficult to grasp, terminology was new, new  
cepts introduced. As a result I don't think those 2 days of training was sufficient, had done any justice  
asically training is of the utter most important to er... drive the process.

: You know maybe mam .. er .. the whole NCS-FET Life Science Policy Document is a very  
mendable document. We must not deny that. I've just been jotting down a few points while you were

: It's ok.

Much of this has been borrowed from international experience like the Canadian experience, Scottish  
British. er.. English I'm referring to. We need to look at how our practical work is done. We need to be

y circumspect, we need to look at this within a local South African context. We need to look at where  
 were, where we are and where we want to go to er... I, know that this has become a sworn song of late  
 what is important er..., you must understand that as science teachers we have been trained in a content  
 ed era, Ash ..um .. we had to push content, subject matter, syllabus and that was it. There's a problem  
 1 that. Today we need to look at learner centeredness. We need to look at the learner as the epicenter  
 focus of learning. The training that people are getting, just as 2 or 3 of our colleagues have alluded to is  
 inefficient. So what we need to look at is there has to be a shift in terms of what kind of training has to be  
 e. How much of training, where, when and how and at what point must the training be a source of er..  
 er a point of intervention. Also to what depth, extent must the training be done. I think a shift in  
 king, er... a common term is a paradigm shift. I would say that a shift in thinking in terms of the  
 ing the extent, depth, quality of training, the period for which it is instituted. I would say we don't  
 e enough of OBE training at the moment.

1 : In terms of resources do we have enough as educators to now go onto this learner centred approach.  
 we have enough resources in our schools ?

: Definitely not, the focus of attention is now the learner and how she or he is able to access the  
 rmation. I would say in our school we do have a limited amount of resources but not all schools in  
 th Africa meet with that requirement, some don't even possess a microscope or library. It's just not

books that's going to provide the information. Natural resources when it comes to science, it's the use of the computer and other media er.. OHP and slide projector and all these are not available in all schools. I think when that condition is met then we could achieve this.

: I can also add there. There is also the argument what's a resource ? anything is a resource, what you have around you is a resource .er... use what ever around " in loco " as a resource. Easy to say, easy to do with basic concepts, certain concepts at the end of the day. At the end of the day teachers do go out of the way, they do use what they have er.. er.. I've worked with rural teachers and I've trained rural teachers, I can tell you this much they try their best. At the end of the day you do have to have certain basic requirements. The basic requirements are not met in certain schools.

: Obviously the lack of resources does impact on the kind of teacher practices that is taking place in the classroom. Now, my next question is , my next quandary is that , where do we situate ourselves in terms of driving the NCS-FET Life Science Policy Document. Right now what's coming through very clearly is that we have this lack of resources, lack of training are there any other factors that could impede us from heading towards this NCS-FET life science policy document.

er ... Can I come in there Ash. I just want to say this much when it comes to policy, this is national policy ok ..er er. We are implementators of policy. At this moment in this point in time we in our classes

lement policy. As science teachers we are implementers of policy. This FET policy document, this FET  
se this is going to be starting soon. I'm saying that we got to do what they want us to do. The challenge  
ng us is can we fulfil the requirement 100 %. I'm saying and I think my colleagues, we're saying we  
going to try, but we won't be able to fulfill it 100 %. What we are going to do ..er.. with the limited  
ing most of us have, we are going to try and measure the two. I'm saying this is a process and er..er..  
ir has said, just now. He say's that this is South Africa and we are developing we don't expect this to  
place overnight. We are going to try to change from that demonstrations and cookbook methods  
ards the hands on.

: t l is there anything else that could influence our practice

: Definitely as I said earlier about the numbers of pupils as much as we want to move towards the  
ls on but its impossible to do with large numbers. I really find that it's a problem to work with 40 or 50  
in a class. Each one setting up the apparatus and doing the work themselves. So I really don't know ..  
it's only when these problems are addressed then this policy may work.

In the requirements of biology and the aspects we need to test theres so many in such a short time. We  
t really, really have time to implement practical work as such. They have a period when you have  
in aspects, 7 or 8 aspects, ja, the assessments this places more pressure on you, you rather complete

the assessments than setting up practical work in terms of the amount of the assessment that we have in biology is too vast.

: Ok I just want to talk about this assessment because you see now at the moment in 2004 the system is used in biology at matric level the method of assessment the evaluation method. What is it ? It's practically tests We just have one system...er... where we can use the rubric where's that

: In the assignment

: Or in the assignment but look at the others ones, its test, mark a test, give a mark that's the way they consider the way to keep consistency in all schools and so on. But if you look at the OBE framework, the framework there are other systems of assessments ..er.. of putting a mark to a learner. That should be used in Grade 12. Maybe we got to look at the method of assessment, the type of assessment that we are using, there could be ways where we could expedite this process, make it easier we need to be trained in these methods.

: More guidance is required in terms of assessments. Assessments is dictating our practice, its all exam oriented.



: A change in mind set , a change in practice, we've been trained in chalk and talk. It makes it difficult is to leave this entire training process in the hands of our learners and just be facilitators. The role of facilitator comes with a lot of responsibility and definitely a change in mind set. We need to take inisance of this, we need to change our whole attitude.

: I'd like to thank you all for being at this presentation but before we finish I'd like to take a luding statement from T 5.

We must change not for the sake of change but for the relevance that it must have for the education of earners. It's going to be very difficult to implement this in a uniform and consistent manner. We must ll our ingenuity, inventiveness and creativity. However while that maybe so it has to come from r levels that more intensified and relevant training needs to be implemented at ground level! k you.

Thank you for your presence. I really appreciated you making time for this presentation.

## BIBLIOGRAPHY

1. Arena, P. (1988 ) : The role of relevance in the acquiring of science process skills. Australian Science Teachers Journal Vol.42, no.4 pp. 34-37.
2. Bell, B & Gilbert J. (1996) : Teacher Development: A model from Science Education : The Falmer Press, London
3. Bennet, C. (2001) : An examination of traditional Games.  
Journal of Physical Education Vol 59, no 7, pp. 42-45.
4. Black, P & Atkin, J (1996) : Changing the Subject: Innovations in Science Mathematics and Technology Education Routledge, London.
5. Bodner, G.M. (1998) : Constructivism: A theory of knowledge.  
Journal of Research in Science Technology Vol 63,no10, pp. 873-878.
6. Brotherton, P.N. & Preece F.W. (1996) : Teaching Science Process Skills  
Journal of Science Education Vol 18, no.1, pp. 65-74.
7. Collussi, M.G (1997) : Practical work in Science teaching in South African Schools for white pupils. A Masters dissertation. Faculty Of Education.  
University of Wits.

8. Cohen, L. Manion, L. & Morrison, K. (2000): Research Method in Education  
Fifth edition. London & New York: Routledge- Falmer Press.
9. De Beer, J.J.J (1993) An evaluative enquiry into the value of practical work  
in Biology teaching at the senior secondary school level  
A Masters dissertation. Faculty of Education Vista University
10. Dekkers, P & Maboyi, T.R (2002) : Science teacher's purpose for doing  
practical work- Does professional development make a difference.  
SARMSTE Journal, 2002 pp. 721-727.
11. Department of Education (1997) : Outcomes Based Education overview.  
Pretoria.
12. Department of Education (2002) : Interim Core syllabus for Biology Pretoria
13. Department of Education (2002) : Guideline document for national exams  
Pretoria
14. Department of Education (2003) : National Curriculum Statement Gr 10- 12  
Overview. Pretoria

15. Department of Education (2003) : National Curriculum Statement Gr. 10-12  
Life Science Policy Document. Pretoria
16. Department of Education (2003) : Integrated Quality Management System  
Policy Document . Pretoria
17. Dillashaw, F.G (1983) : The relationship between Science process skills and  
formal thinking ability. Journal of Research in Science Teaching, Vol. 20, no.3  
pp.239 – 246.
18. Driver, R & Oldham, V. (1985) : A constructivist approach to Curriculum  
development in science. Studies in Science Education. Vol. 13, pp 105-122.
19. Driver, R; Asoko, H. Leach, J.; Mortimer, E. & Scott, P. ( 1994 ) :  
Constructing Scientific knowledge in the classroom:  
The educational Researcher Vol, 23, no. 7, pp. 5-12.
20. Duggan, S. & Gott, R. (2002) : What sort of science education do we really  
need ? International Journal of Science Education. Vol. 24, no.7 pp. 661-679.
21. Flavell, J. (1992) : Cognitive Development: past, present and future.  
Developmental Psychology, Vol. 28, pp. 998-1005.

22. Fosnot, C.T. (1986) : Rethinking science education: A defence of Piagetian Constructivism. Journal of Research in Science Teaching, Vol, 30, no.9, pp. 1159 – 1201.
23. Fosnot, C.T. (1989) : Enquiring teachers, enquiring learners: A Constructivist approach for teaching. New York: Teachers college Press
24. Fullan, M.G. & Hargreaves, D.H. (1992) : The new meaning of Education change. New York: Teachers College Press
25. Goh, N.K, Toh, K.A. & Chia, L.S. (1989) : Use of modified laboratory Institutions for improving science process skills acquisition. Journal of Chemical Education, Vol. 66, no.5, pp. 430-432.
26. Hackling, M.W & Garnett, J. (1995) : Refocusing the chemistry lab: A case For laboratory based investigations Australian Science Teachers Journal, Vol .41, no.4, pp. 80-86.
27. Howe, A.C. (1996) : Development of Science Concepts within a Vygotskian Framework: Science Education Journal Vol, 80, no.1. pp. 35-51.

28. Huppert, J. & Lazarowitz, R (2002) : Computer Simulation in the high school: Students cognitive stages, science process skills and academic achievement in Microbiology. International Journal of Science education, vol. 24, no. 8, pp .803 – 821.
29. Mc Kereghan, D.L (1988): Quantitative Vs Qualitative research.  
A attempt to clarify the problem : 1-2 online
30. Miller, R & Driver, R. (1987) : Beyond Process. Studies in Science Education Vol. 14, pp. 33-62.
31. Moodley, T.K. (1972) : A Critical Survey of Practical work in Biology at the Senior Secondary Indian High Schools in Natal.  
A Masters Dissertation. Faculty of Education, UNISA.
32. Novack, J.D & Gavin, D.B (1984) : Learning how to Learn Cambridge: Cambridge University Press
- 33 'O Loughlin, M (1996) : Rethinking Science education: Beyond Piagetian Constructivism towards a socio cultural model of Teaching and learning. Journal of Research in Teaching Vol. 29, no.8, pp. 791-820.

34. Osborne, J.F (1996) : Beyond Constructivism: Science Education  
Vol. 80, no. 1. pp. 53-82.
35. Osborne, J.F & Wittrock, L. (1985) : The generative learning model and its  
implication for science education. Studies in Science education, Vol. 12,  
pp .59-87.
36. Oxford Dictionary
37. Padilla, M (1990) : Research matters to the science teacher  
<http://unr.edu/homepage/jcannon/skills/htm>
38. Padilla, M. Okey, J.R & Dillashaw, F.G. (1994) : The effect of instruction  
on integrated science process skill achievement. Journal of Research in  
Science Teaching. Vol. 21, no. 1, pp. 277- 287.
39. Piaget, J. (1967) : Cognitive development in children: Development and  
Learning. New York. Columbia University Press
40. Poliah, R.R. (1993) : A survey of the perceptions and attitudes of pupils and  
teachers to practical work in Indian Secondary Schools in the PWV area in  
the Transvaal. A Masters dissertation Faculty of Education.University  
of Wits.

41. Rodriguez, A.J. (1998) : Strategies for counter resistance: Towards socio transformative constructivism and learning to teaching science for diversity and for understanding. Journal of Research in Science teaching Vol 35, no.6, pp. 589 – 622.
42. Saunders, M. (1999): Implementing Outcomes Based Education in South Africa: What lessons can science educators learn from Classroom practioners in New Zealand, Proceedings, 7<sup>th</sup> saarmse conference, Harare, January 1999: 382-405
43. Screen, P. (1986) : Warwick process science: Southampton Ashford Press.
44. Staer, H, Goodrum, D. & Hackling, M. (1995) : High School laboratory work in Western Australia: Openess to inquiry.  
Australian Science Education Research Vol. 42, no. 4, pp 35-46.
45. Vadeboncoeur, J. (1997): Child Development and the purpose of education: A historical context for constructivism in teacher Education. Washington, DC : Falmer Perss
46. Van den Akker (1998): Implementations of (2005 in Mpumalanga: Towards a theory of implementation: University of Pretoria-online



47. Valanides, N.C.(1998) : Formal reasoning and science teaching. School Science and Mathematical Journal Vol. 21, no. 7, pp. 277-287.
48. Vaughn, S, Schumn, J.S & Sinagub, J.(1996) : Focus group interview in Education & Psychology. United States of America ; Sage Publishers
49. Vithal, R & Jansen, J. (1997) : Designing your first research proposal:  
First Edition: Juta & Co LTD
50. Vygotsky, L. (1986) : Thought and Language (A: Kozulin Trans): Cambridge M.A : M.T Press
51. Wellington, J.J (1994): "What's supposed to happen, Sir?: Some problems with Discovery learning" School Science Review, 167-173.
52. Westbrook, S.L & Rogers, L.N (1994) : Examining the development of Scientific reasoning in ninth grade physical Science students. Journal Research in Science teaching. Vol. 31, no. 1, pp. 65-76.
53. White, L. (2002) : Process skills: Are teachers Equipped and Ready to Implement ? [lounell@freemail.absa.co.za](mailto:lounell@freemail.absa.co.za)

54. Woolnough, B. & Allsop, T. (1985) : Practical work in School Science.

Cambridge University Press.

55. Woolnough, B. (1991) : Practical Science London: Open University Press.