Investigating Curriculum Policy and Implementation of The Interim Core Syllabus For Biology in Grade 10 at One Secondary School at Imbali Township. Pietermaritzburg

By

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DECLARATION

Unless otherwise indicated in the text, this dissertation represents my own work. Opinions expressed and conclusions arrived at, are those of the author.

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CONTENTS

CHAPTER ONE

INTRODUCTION

This study attempts to give a limited picture of what is currently happening in schools prior to the implementation of the new Further Education and Training (FET) National Curriculum Statements (NCS). At the time of this study, schools are using the Interim Core Syllabus (ICS) in grades 10 – 12. This syllabus was designed after 1994 i.e. when South Africa became a democratic country. The Apartheid syllabus had to be changed. The offensive language, pictures and content had to be removed. The Interim Core Syllabus was introduced in the interim while the new curriculum was finalised. The focus of this case study is a grade 10 Biology class. The study was conducted in one school with one teacher teaching the same group of learners for five consecutive lessons. The aim is to investigate how teachers understand and implement the ICS with the main focus on the following two questions:

- What are the framing relationships between the teacher and the learners?
- What are the classificatory relationships between Biology and other subjects, between different sections of Biology and between Biology and everyday knowledge?

The 1996 Biology Interim Core Syllabus (ICS) (grade 10) and the 2003 Life Sciences grade 10 National Curriculum Statements (NCS) policy documents were also analysed in terms of:

- Framing and
- Classification

This study is an attempt to make a contribution to a project that is being conducted by the University of KwaZulu-Natal (UKZN) and funded by the National Research Foundation in an effort to answer the question:

"What happens to the reform process as it is translated or re-conceptualised from curriculum statements down to the learners in the classroom?"

This study is necessitated by the major changes that are taking place in the South African education system since the introduction of democracy in 1994 (Jansen, 1999; Jansen & Christie, 1999; Chisholm, 2004; Muller & Taylor, 2000). This section will give a brief overview of these changes that were introduced by Professor Sibusiso Bhengu, who was the first Education Minister in the new democratic South Africa. The curriculum reform was a response to a white paper on Education and Training (1995) that called for an education reform that would address the imbalances of the past (Muller & Taylor, 2000). For the reform to be acceptable it had to create social justice by providing equal access to quality education. On the 26th of February 1997, the Council of Education Ministers (CEM) took a decision to "replace Apartheid Education by an Outcomes-Based Education (OBE) in the General and Further Education and Training Bands" (DoE, 2003). The original plan was to phase in OBE into both the General Education and Training (GET) band and the Further Education and Training (FET) band by 2005. As a result this curriculum reform was called Curriculum 2005.

The environment in which the implementation of Curriculum 2005 took place was characterised by "enormous infrastructure backlogs, resource limitations, inadequate supply of quality learning support materials and absence of common national standards for learning and assessment" (DoE, 2003). These inequalities resulted from the different education systems that had served to prepare different race groups for the different status positions that they were to occupy later on in their lives. Poorly resourced schools had supplied inferior education that had been tailor made to prepare Blacks for their subordinate positions in life while there was high quality education for Whites to prepare them for the leadership positions that they would have to take (Adler, 2000; Ensor, 2004). This system of historical inequality meant that many poor rural schools failed to implement the new curriculum. Malcolm (1999) describes this situation as a 'voyage of faith' where teachers were sent out with the hope that they could meet the challenges of implementing a new curriculum in an under-resourced system without support (Harley & Wedekind, 2004 ; Sayed & Jansen, 2001). In 1999 Curriculum 2005 was in its second year of implementation when Professor Kader Asmal became the Minister of Education. The Minister started a campaign to determine the progress and challenges experienced since the implementation of OBE in the GET band. Many interest groups expressed frustration with the design and implementation of Curriculum 2005. As a result of these concerns expressed by the interest groups, the Minister set up a committee in February 2000 to review the implementation of Curriculum 2005.

On the 31st of May 2000 the Curriculum 2005 Review Committee presented its report that confirmed the limitations and recommended that the curriculum be streamlined and strengthened. In November 2000 the Minister appointed a Ministerial Project Committee to manage the streamlining and strengthening of Curriculum 2005 for grades R-9.

The Committee released a clearer and simpler version of Curriculum 2005 for public comment between the 30th of July and the 12th of October 2002 (DoE, 2003). The public welcomed the simpler version of Curriculum 2005. The Revised National Curriculum Statements (RNCS) for grades R-9 were approved by the Cabinet and endorsed as policy by the Council of Education Ministers (CEM) on the 15th of April 2002.

These changes in the GET Curriculum 2005 impacted on the FET Curriculum 2005. The original plan by the CEM on the 26th of February 1997 was to develop a new curriculum for FET to be phased in in 2003/2004 and completed in 2005. This plan had to change on the 19th of March 2002 when the Heads of Education Committee (HEDCOM) proposed the incremental phasing in of OBE into grade 10 in 2004. This proposal was approved by the CEM who called for the development of the National Curriculum Statements (NCS) for FET by March 2003. These NCS for FET were to be based on the principles and design of the RNCS for grades R-9 with the key principles (DoE, 2003) being:

- High knowledge and skills for all,
- Human rights,
- Inclusivity,
- Socio-economic and environmental justice,
- Articulation and portability,
- Integration and progress,
- Outcomes-based approach and credibility,
- Quality,
- Efficiency and
- Relevance.

In order to improve the state of readiness of the FET band to cope with the curriculum and institutional changes there were further delays, however, with plans for OBE to only be phased into grade 10 in 2006. The delay in the phasing in of OBE to the FET band meant that the 2003 grade 10 will have to be taught the 'old' syllabus though they have been exposed to OBE since their 7th grade. Fortunately the 2003 grade 10 learners were not going to be taught in the original 'old' syllabus (DoE, 2003) as much had been done since 1994 to ensure that the Senior Certificate was improved. As the DoE (2003).; Taylor, Muller & Vinjevold (2003) and Fleisch (2000) point out this included learning outcomes being developed and languages becoming standardised following the recommendations of the Committee. In addition the Scottish Qualifications Authority found the Senior Certificate to be comparable to other reputable examination systems and qualifications, five common examination subjects were written for the first time in 2001 and continuous assessment was introduced in the FET band in 2001. All these changes were implemented in the interim while waiting for the phasing in of OBE into the FET, a band that is optional to those learners who wish to further their studies beyond the compulsory education, generally those learners who want to go on to higher education institutions. As a result of these changes and learners' requirements, FET will change from 2006 onwards with phasing in at grade 10 level, from the Interim Core Syllabus (ICS) that is aims and objectives driven, to FET National Curriculum Statements (NCS) that are influenced by the labour market and political vision (Chisholm, 2004.; Young, 2003).

The aim of this study is to describe what is currently happening in Biology in grade 10. This study is attempting to answer one key question namely: **How do teachers understand and implement the Interim Core Syllabus for Grade 10-12?** Two factors were focussed on:

- The teacher – learner relationship (framing)
- How the subject was organized and classified (classification)

The study forms part of a bigger FET project funded by the National Research Foundation (NRF) that will be carried out over a period of four years by the University of KwaZulu-Natal in Pietermaritzburg. The project was started in 2004 and will continue until 2007. The central question that this FET – NRF project is addressing is "What happens to the reform project as it is translated or re-conceptualised from curriculum statements down to the learners in the classroom?"

This study is one of many similar studies that will explore current practices in a variety of school discourses to see how current practices relate to social justice as envisaged in the South African Constitution. This description of what is currently happening might help curriculum planners at the state level to make informed decisions on curriculum changes, thus ensuring that the new FET curriculum achieves its aims and overcomes the challenges that were faced when GET- NCS were first introduced i.e. unintentionally producing contradictory effects (Ensor, 1999; Muller, 2004.; Adler, Pournara & Graven, 2000).

As a teacher I have been in the education system for seventeen years, though not teaching Biology. I teach in both the GET band and the FET band. Having experienced different curriculum policies both as a teacher and a learner, I believe that I can make a useful contribution to this FET project. I hope that this study will be useful to those researchers who will compare the Interim Core Syllabus For Biology with the FET Curriculum in 2006 to 2007. This study may also contribute to the curriculum reform studies that have been conducted in other countries with a similar background to that of South Africa. One good example of such a study is the one that was conducted by Morais & Neves in Portugal in 1999. In this study, Morais et al analysed the Natural Science Syllabuses of the 5^{th}, 6^{th} and 7^{th} years of schooling (ages 10-13) to investigate the extent to which the then Portuguese reform (1991) for elementary school introduced fundamental changes in the discourses and competences it valued (Neves & Morais, 2001).

South African studies that dovetail with my own minor case study have been conducted by Dowling (1993); Hoadley (2005) Adler (2000) and Davis (1998). Similar studies are being conducted here in South Africa by a group of researchers funded by the National Research Foundation (NRF). Though group members conduct these studies individually, each study is intended to make a contribution towards this NRF- FET project. All these studies are conducted in KwaZulu-Natal in different schools with different contexts in terms of human and material resources with the intention that a clearer and fuller picture will emerge to reveal what is really happening now in FET schools before the introduction of the FET - NCS.

This study is an intensive case study conducted in one school, involving one teacher and one class. Adler (2000) argued that in-depth case studies are required so that claims about substance teaching with an emphasis on understanding as opposed to procedural teaching with an emphasis on rote learning could be made.

Here the Biology teacher was observed teaching the same class over five lessons in order to observe the teacher in continuity of her practice (Adler & Reed, 2000). This was done in order to minimise variables and conduct in-depth study. All the lessons were recorded on audio-visual tape and then put onto DVD as a back up. After observing the lessons, the teacher and the learners were given questionnaires and responded in writing because I did not have access to the audio- tape recorder at that time. I gave the teacher the questionnaire after discussing the questions so that she could answer them in her own time. The learners were given an hour to respond to the questionnaire. I explained the questions where learners did not fully understand and allowed learners to respond in their mother tongue if they experienced difficulties expressing themselves in English. I assured the learners that their personal identities would remain anonymous. To ensure this I asked them not to write their names on their responses. The same assurance was given to the teacher. As a result, the real names of the school and the teacher will not be used.

In this chapter I have explained the background of the FET project and the rationale for doing this study. I will now give a brief overview of the chapters to follow:

- Chapter two explains the theoretical framework of this study. All the concepts used in the study are defined and discussed. The research methodology used also forms part of this chapter.

- Chapter three reviews the literature that is related to this study.

- Chapters four and five capture the analysis of the data collected, starting with a comparative analysis of the two policy documents: the 1996 Biology Grades 10- 12 Interim Core Syllabus (ICS) and the 2003 Life Sciences for Grades 10- 12 National Curriculum Statements (NCS). This is followed by a general description of what happened during lesson observations and interviews. An analysis of the questionnaires' responses and the observed lessons is then done using an external language of description.

- Chapter six includes the research findings, recommendations and the conclusion.

This study is very limited but as a case study it forms part of a bigger project and as such it is hoped that it will make a useful contribution to the research community. Adler & Reed (2000) call this kind of a study a baseline study. Studies to be conducted in 2006 up to 2008 could build onto this baseline study.

CHAPTER TWO

THEORETICAL FRAMEWORK AND RESEARCH METHOD

2.1.Theoretical Framework

In this chapter I will explain the concepts that are used to describe the findings of this study. The explanation will show the meanings attached to each concept for the purposes of this study. This is done in order to prevent any misconceptions that may occur as these concepts can have more than one meaning.

This study is located within the social sciences and works within an interpretivist paradigm. Interpretivist researchers try to find out what is happening in the researched context by analysing and interpreting data using theories or concepts that provide the language of description for the data (Harley & Parker,1999 in Graven, 2002).

In this study, a number of Bernstein's concepts were used. Classification, framing, hierarchical analysis, recognition rules and realization rules were mainly used to explain what was observed in Biology lessons. These concepts were chosen because they provide an internal language of description. By internal language I mean a conceptual language that describes the functioning of the terms themselves.

According to Bernstein (1971, 1982, 1996, 1999, 2000) **classification** refers to power relations between different agencies, contexts or discourses. In this case I will look at classification in terms of:

- Boundaries between subjects, i.e. inter-disciplinary, for example boundaries between Biology and other school subjects;
- Intra-disciplinary boundaries within one subject namely Biology - looking at how different topics within the subject are ordered, whether they are integrated or separated.
- Inter-discursive boundaries, i.e. the boundaries between the community code (which is restricted and context-based) and the school code (which is elaborated and context independent) (Bernstein, 1996).

The term community code refers to an everyday or common sense knowledge that is locally shared. The school code refers to the uncommon sense knowledge or the official knowledge that is learnt at school.

Bernstein (1996), states that classification can be weak or strong and he uses codes to indicate the value of classification. C+ indicates a strong classification and C− indicates weak classification. According to Morais & Neves (1999), classification in the classroom situation can be very strong (C++) which means that the subject is highly insulated from the outside influences, only the specialised concepts are used in that classroom. Learners need to avoid using concepts or terms from other subjects in that lesson. Here each subject is treated as a singular. A discourse as a singular is a discourse that has appropriated a space to give itself a unique name (Bernstein, 1996).

According to Bernstein (1996), **singulars** (i.e. compartmentalised, independent, 'stand-alone' subjects where knowledge/concepts are not transferable across different subjects) have changed to **region** (i.e. where there is an integration/transfer of knowledge/skills/use of concepts across the different subjects; and teaching/learning in one subject reinforces and is reinforced in the teaching and learning of another subject) (DoE, 1997). Strong classification (C+) means that though the subject might retain its uniqueness, it does allow concepts from other related subjects to be used within its space. This is a mixture of collection code (singular) and integrated code (region). Due to continuous recontextualization of knowledge, inter-disciplinary classification has further been weakened (i.e. the boundaries between subjects have been broken down). This occurred in South Africa when Outcomes Based Education (OBE), which promotes the integration of subject knowledge (Graven, 2002), was introduced. An example of this subject knowledge integration with its weak classification (C−) was the changing of subjects into learning areas, for example General Science was changed to Natural Science which combines Biology and Physical Science in the GET phase.

These three classification codes (C++, C+ and C−) apply to inter-disciplinary, intra-disciplinary and inter-discursive classifications. Very strong inter-disciplinary classification (C++) means that the subject is maintaining its singular status.

According to my understanding, where inter-disciplinary classification is strong (C+), this means that the singular has partly changed to region, and where classification is weak (C−), this means that the subjects have been changed into a learning area. Very strong intra-disciplinary classification (C++) means that the topics within the subject are highly separated and insulated from each other, each topic is independent from the other. Strong intra-disciplinary classification (C+) means that there are some links between different topics within a particular subject. Weak intra-disciplinary classification (C−) means that the topics within a particular subject are inter-dependent on one another; there are links between different topics.

Inter-discursive classification follows the same pattern as inter-disciplinary and intra-disciplinary classifications. The difference is that inter-discursive classification looks at the boundaries between school code and community code. Very strong classification in this case will mean that only the school code is acceptable in that subject or school or classroom. Only the school code is considered to be a legitimate text. Strong classification (C+) means that the community code is used within the school context to a minimal degree to clarify some school code concepts. Weak inter-discursive classification means that the community code has an equal value as the school code within the school context. Anything said by the learners within the classroom is accepted as a legitimate text (Hoadley, 2005). Figure 1 below explains the classification relationships between subjects; within a particular subject; between the school code and the community code as well as spaces between the teacher and the learners. If classification of spaces between the teacher and the learners is strong, it means that the teacher does not share his/her space with the learners. The teacher might remain standing in front of the class by the chalkboard. He/she does not move around between the learners' desks. Learners also do not come up to the board to write or paste something. Teacher's space and learners' space are completely separated.

CLASSIFICATION

Classification	Relations between discourses	**Inter-disciplinary** (strength of boundary between Biology and other subject areas)
		Inter-discursive (strength of boundary between school Biology and everyday knowledge)
		Intra-disciplinary (strength of boundary between topics within Biology)
	Relations between spaces	**Teacher-learner** (strength of demarcation between spaces used by teachers and learners)

Figure 1 (Ensor and Hoadley,2004)

Framing is the second Bernsteinian concept that is used together with classification. As classification is concerned with power, framing focuses on control. According to Bernstein (1996) classification and framing complement each other. While classification stipulates boundaries, framing explores how the boundaries are negotiated (Bernstein, 1982, 1996). Bernstein (1996), defines framing as referring to the "controls on communication in local interactional pedagogic relations between parents/children; teacher/ pupil, social worker/ client etc".

In this study, framing focuses on the relationship between the teacher (transmitter) and the pupil (acquirer) within the classroom in terms of selection, sequencing, pacing and evaluation - "Where framing is strong, the transmitter has explicit control over selection, sequence, pacing, criteria and the social base" (Bernstein, 1996). Conversely framing is weak when the acquirer has more control over the communication and its social base (Bernstein, 1996). Strong framing is similar to what is known as the teacher-centred approach and weak framing is a learner centred approach. The key here is "who controls what" (Bernstein, 1996). Figure 2 below clarifies the framing relationships in terms of the discursive rules and hierarchical rules.

FRAMING

Framing	Discursive rules	Extent to which teacher controls **selection** of content
		Extent to which teacher controls **sequencing** of content
		Extent to which teacher controls **pacing** of content
		Extent to which teacher makes explicit the **rules of evaluation** of learners' performances
	Hierarchical rules	Extent to which teacher makes formal or informal the social relations **between teacher and learners**
		Extent to which the teacher controls interactions **between learners**

Figure 2 (Ensor and Hoadley, 2004)

According to Bernstein (1996), there are two systems of rules regulated by framing namely:

- Regulative discourse i.e. the rules of social order, and
- Instructional discourse i.e. the rules of discursive order.

The rules of social order control the hierarchical relations between the transmitters and acquirers within the classroom situation. These rules allow the transmitter to label the acquirer as 'attentive' or 'disruptive', for example.

This labelling is easily achieved when framing is strong. Where framing is weak, labelling becomes difficult, even for the acquirer who struggles to make his/her own mark by being creative or interactive.

The second rule is the rule of the discursive order that refers to selection, sequence, pacing and criteria of the knowledge (Bernstein, 1996). The discursive rules are always embedded in the social order rules (i.e. framing = instructional discourse over regulative discourse).

The regulative discourse, i.e. social order rules, is always dominant in relation to discursive rules\instructional discourse (Bernstein, 1996). The value of framing can change between the discursive rules and the social order rules. Generally framing is strong when regulative and instructional discourses are explicit. In this case, pedagogic practice is visible.

However, where framing is weak, regulative and instructional discourses are implicit and mainly unknown to the acquirer (Bernstein, 1996).

The value of framing and classification can be indicated by these pedagogic codes namely: + representing a strong value and – representing a weak value. F stands for framing and C stands for classification so C+ and F+ represent strong classification and strong framing respectively, while C – and F – represent weak classification and weak framing respectively. To add to these pedagogic codes classification and framing (weak or strong) have an internal as well as external value. A small 'i' means internal to the unit of analysis and a small 'e' means an external value to the unit of analysis. With E standing for 'elaborated orientation' (Bernstein. 1996), this can be represented as a formula:

$$\frac{E}{\pm C\,i.e\ /\ \pm F\,i.e}$$

The relationship between classification and framing can be summarised as such: **classification** means power to create boundaries between agents or discourses and **framing** means control measures put into place to ensure that boundaries are kept and legitimised. Once this relationship is understood, the relationship between the principle of classification and the development of recognition rules can be worked with (Bernstein, 1996). According to Bernstein, recognition rules refer to the recognition of the speciality of the context, i.e. the learner recognises the school context and responds accordingly. This was evident with the middle class learners in Bernstein's food experiment (Bernstein, 1996, 2000; Hoadley, 2005) who recognised the school context and grouped food according to context independent principles. As classification indicates how one context differs from another, weak classification can make it difficult for the acquirer to recognise the speciality of the context, thus making it extremely difficult for him/her to make suitable selection, sequence or pacing choices i.e. to achieve the realization rules by producing a legitimate text. Incidentally, framing is related to the development of the realization rule.

The achievement of the recognition rules means that the individual has the ability to recognise the boundaries between contexts. In the transmission and acquisition situation, the achievement of the recognition rule will mean that the acquirer (learner) is able to recognise what it is that the subject or the context is about. Achieving the realization rule, on the other hand, means the ability to articulate and apply what one has recognised, meaning that the acquirer is able to create the legitimate text based on the context. While recognition rules operate between contexts, realization rules operate within contexts. Lastly, the term 'text' refers to anything that can be evaluated. A legitimate text can only be created by an individual who has achieved the realization rule. (Bernstein, 1996).

Another concept related to the concepts explained above that is used in this study is **hierarchical analysis**. According to Hugo (2005) "hierarchy is basic to our very functioning". In the same vein, hierarchy cannot be excluded from the classroom situation. In this study, hierarchical analysis focuses on the relationship between the teacher and the learner (transmitter-acquirer relationship). This hierarchical analysis concerns the relationship between the learner and the contexts surrounding the learner. Context in this case means what is used in that teaching and learning situation, what seems to be the source of knowledge for that particular subject learnt in that classroom. It can include drawings, learners' notes, what is written on the board as well as textbooks. Lastly, the relationship between the learner and the subject knowledge (content) is what is known as intensional hierarchy.

Before showing the relationship between hierarchical analysis and classification and framing and recognition and realization rules, I will briefly explain what hierarchical theories entail. According to Hugo (2005) the word hierarchy means "sacred order or rule". Hierarchy works in a particular direction, once this direction is changed, the meaning also changes, for example when a learner moves up the grades, he/she increase the complexity of learning. If he/she moves down the grades, the complexity of learning is decreased. To further clarify the meaning of hierarchy within education, I will explain the three kinds of hierarchy that are at work in education, and then further describe the eight basic forces that are at work in hierarchy.

According to Hugo (2005) there are three kinds of hierarchy at work in education namely;

- The nested vs. non-nested hierarchy;
- The extensional hierarchy and
- The intensional hierarchy.

The nested forms of hierarchy means that the earlier parts of the hierarchy are included within itself as the hierarchy moves up (Hugo, 2005), for example classrooms are within the school, which is within the district in the province. In other words a school cannot exist without classrooms and the district cannot exist without schools. A non-nested form of hierarchy, on the other hand, does not include its earlier parts within itself. An example of this is management hierarchy within educational structure - there are clear levels of authority but not inclusive relationships. A headmaster does not include inside of himself various teachers.

Within the nested hierarchy, there are two types of hierarchies, namely:

- Extensional nested hierarchy and
- Intensional nested hierarchy.

To refer back to the example of classrooms, school, district and province used under nested hierarchy, this very same example is an example of an extensional nested hierarchy. The context or environment is enlarging as one moves up the extensional nested hierarchy. It gets bigger and bigger, for example the school is bigger than the classroom and the district is bigger than the school, so is the province bigger than the district.

Intensional nested hierarchy does not work with extension, but with intensions. Earlier, I gave an example of learners moving up the grades. I said the learners are increasing the complexity of knowledge. This is similar to the intensional hierarchy where one moves from concrete to abstract i.e. from simple forms of knowledge to more complex forms of knowledge - movement of knowledge from local to general (Breier, 2004). Intensional hierarchy finds its increasing span through its application not its size (Hugo, 2005). Abstract principles apply to a wide range because these become more generalized.

There are **eight forces** working in hierarchy. Four works from within the hierarchy and the other four work from outside the hierarchy. Forces that work from within the hierarchy are:

- Self-preservation,
- Accommodation,
- Atomising and
- Emergence.

Self-preservation means that the discourse is maintaining its uniqueness. The boundaries between agents or subjects are strong. The discourse protects itself from outside influences. Accommodation works in an opposite direction to self-preservation.

Accommodation means that the subject opens up and allow outside influences to shape it or change its structure in order to fit in with its context.

Atomising means breaking down to its simplest form. This is a downward movement, from abstract to concrete. This occurs when knowledge is broken down to its basic elements to facilitate understanding.

Emergence is the opposite of atomising. It is a movement from local to general (Breier, 2004), from concrete to abstract or higher orders of generalisation.

The four forces that work from outside are called **zones**. These are:

- Zone of exclusivity;
- Zone of inclusivity;
- Zone of potential and
- The zone of probability.

These zones are related to the forces that work from within the hierarchy.

Firstly, the **zones of exclusivity** operate at level zero together with the force of self-preservation. Here the discourse does not allow any outside knowledge to influence its context. In other words the zone of exclusivity strengthens classification. It ensures that the discourse maintains its exclusiveness.

The **zone of inclusivity** also operates at level zero but in an opposite direction to the zone of exclusivity. The zone of inclusivity weakens the boundaries between agents or subjects. It

weakens classification by allowing the outside influences to shape its structure. This zone works together with an internal force called accommodation.

The third zone, the **zone of potentiality,** operates at level minus one or lower. It works together with atomising force. Zone of potentiality means that those broken concrete atoms have a potential to be built up to higher levels of abstraction. According to Breier (2004), the zone of potentiality means that the personal localized knowledge can be selected and developed into personal general knowledge. This personal general knowledge can further be developed into impersonal general knowledge. In other words, the zone of potentiality means that there is a possibility to select from this concrete knowledge and explain concrete knowledge.

The last zone, the **zone of probability**, works together with emergence at a higher level. It works upwards showing the possibility of the formation of new concepts of a higher order. (i.e. the emergence of new impersonal general concepts).

All these concepts give me an internal language of description - describing theoretically what is happening inside the classroom. I have chosen these concepts because they are all related and useful in describing what happened in this case study. While classification focuses on the strengths of boundaries between different agencies, context or discourses. In this study, classification focuses on the strengths of boundaries between Biology and other subjects (inter-disciplinary); the strengths between different topics within Biology (intra-disciplinary) and the strengths of boundaries between the community code (everyday language or knowledge) and the school code (subject content or concepts) i.e. an elaborated orientation obtained from school (inter-discursive). Framing on the other hand focuses on the relationships between the teacher and the learners within the classroom as well as the relationship between the teacher and the curriculum designers through the policy documents. The focus is on who controls what. Hierarchy theory enabled me to not only break down the lessons into their classification and framing parts but to also look for the way knowledge was built up and organized within the lessons. However, the main part of this thesis looks at Classification and Framing rules, with Hierarchy theory offering a possible future development for my analysis.

2.2.Research Methodology

This study falls under the interpretivist paradigm. It followed a case study approach, combined with questionnaires. I will also look at learners' portfolios. These different methods will be used for triangulation purposes to address the question of validity and reliability. This study is a practice-based case study that will try to learn from the teacher's classroom practice with the focus on the teacher-learner relationship (in practice) and compare that to policy (Adler & Reed, 2000).

Bassey, in Adler & Reed (2000) identifies two kinds of empirical study in educational research. There is a research for generalisation i.e. one that involves a large population through careful sampling, and a research for singularities i.e. a case study. This study is an example of a singularity research, as it does not aim for generalisation. Only a fuzzy generalisation can be made from this case study. Bassey (an experienced researcher) came up with this notion of fuzzy generalisation after seeing a number of quality studies not impacting on teachers or policy makers because the findings were too specific and therefore could not be generalised (Adler & Reed, 2000).

This case study was conducted in a Secondary School, specifically in a grade 10 Biology class. Firstly, I asked for permission from the principal and the teacher. After obtaining the necessary permission I started video taping the Biology lessons. Due to time constraints, I asked someone to tape all the lessons for me. I observed five lessons and then had a questionnaire at the end of the session with the teacher. Learners were also given a questionnaire at the end of the five lessons observed. Learners' books were perused in order to support observation, copies thereof form part of the raw data collected. Adler and Reed (2000) state that learners' books can reflect the kind of subject knowledge valued by the teacher through "inscription and attempts at practice and mastery".

I analysed the Interim Core Syllabus and the National Curriculum Statements for FET. I looked at their structures and sentences classifying them as, either very strongly framed (F++), strongly framed (F+) or weakly framed (F−).

I only considered the sentences with framing relationships and ignored other statements. I therefore became familiar with the policies.

I decided to look at the secondary school where I teach and so it allowed for easy access to the school. I observed one teacher in this school. I did not have any problems in gaining access since I am not an expert in the subject therefore the teacher had no reason to feel intimidated by the presence of the video camera in her classroom. I also explained to her that I intend teaching this subject in the near future. The study would be a learning experience for me as well.

For ethical reasons, I explained clearly to the principal, teacher and learners that I was conducting research on trying to describe the current practices in Biology grade 10 classes and that the study is part of the FET project conducted by the University of KwaZulu-Natal (Pietermaritzburg Campus). I also gave all stakeholders the assurance that findings would not be used against anyone participating, as their identities would remain anonymous.

In conducting this study, lessons were observed, transcribed and analysed according to classification and framing, hierarchical analysis and recognition and realization rules. The school consists of about 740 learners and 24 teachers including the principal, two deputy principals and four heads of departments.

There were no special methods used to select the participants in this study. My choice was influenced by my research topic and the convenience of the school. I approached the Biology teacher and asked for her permission to observe her lessons in grade 10 and she agreed. Incidentally, the school has one Biology teacher, teaching Biology from grade 10 to 12. I explained to her that I needed to observe her teaching one group (class) of learners over five lessons. The teacher then decided on the class that I observed.

The class consisted of about sixty learners. On average, these male and female learners are aged between fifteen and nineteen years old. These learners have supposedly been taught in an outcomes based education (OBE) style since their 5th grade so they should have been used to group activities and a 'learning by doing' method of teaching. Most of these learners come from poor socio-economic backgrounds and poor educational backgrounds.

The teacher is well qualified and experienced in teaching Biology in grade 10 to grade 12. She has taught these grades for over ten years. She has been exposed to marking grade 12 final examination scripts as a senior marker. I think the teacher is well informed about her subject and she knows the subject content well. This was evident during her lessons, as she did not keep on referring to the textbooks while teaching. As a result, her learners seemed to depend on her as a source of information.

This is a small- scale study since the participants are limited to one teacher and one group of learners in one school. This makes it difficult to generalize on the findings, but it does allow for an in-depth analysis of the lessons observed as well as the teacher and learners' responses to the questionnaires.

According to Stenhouse (1985), there are four styles of case study namely:

1. **Ethnographic case study** i.e. a study conducted by an outsider without informing the participants in the study.

2. **Evaluative case study** i.e. an in-depth study of a single case or a collection of cases used to collect information that may help decision makers make informed decisions with regard to policies, programmes or institutions. This study is an example of an evaluative case study. Though this study has some characteristics from other styles of case study.

3. **Educational style** i.e. one used to enrich the thinking through reflective documentation of evidence.

4. **Action research case study** i.e. one which will contribute to 'revision and refinement of action'.

Dowling (1993) uses the term 'opportunity sampling' to describe what occurs in case studies and believes that educational researchers often attempt to put a 'gloss of deliberation' onto this opportunity sampling when they refer to it as a case study. He also points out that essentially all research can be called case study research in so far as it makes claims about one or more specific cases of or in relation to a broader field of instances of phenomena.

Different methods of data collection were used. Firstly, policy documents were analysed, then the teacher was observed teaching Biology to grade 10 learners for five days. Thereafter the teacher was given a questionnaire and wrote down her responses. Lastly, learners (i.e. the same group of learners observed) were given a questionnaire. They also wrote down their responses to the questionnaire. Twenty-one out of sixty learners responded to the questionnaire. Four randomly selected learners' books were looked at, but were not analysed in detail for this study.

The study falls under the interpretivist paradigm as it is trying to understand what is going on in the classroom and explain that. Data analysis will use both qualitative and quantitative methods. It will be qualitative because data collected was interpreted using Bernstein's language of description. It is quantitative in that concepts used during the lessons were counted and then categorised in terms of content and skills and lastly traced as to how many times a term was used during the five lessons. A qualitative comment will be made concerning conceptual count analysis linking that with knowledge hierarchy. The unit of analysis in this study are the lessons. These lessons will be analysed in terms of framing and classification, conceptual count and knowledge hierarchies, which will show the recognition and realization rules in terms of context, control and content (intensional hierarchy).

The lessons were coded using three different types of classification relationships, namely:

- Inter-disciplinary,
- Intra-disciplinary and
- Inter-discursive relationships.

Inter-disciplinary classification focuses on the relationship between Biology and other subjects, looking at the boundaries between Biological knowledge and procedures and those of other subjects.

Inter-disciplinary classification is said to be very strong (C++) if the subject is unique, using only its own concepts and the subject is self-preserving and operates at the zone of exclusivity (Hugo. 2005). In other words, the boundaries are very strong separating Biology from other subjects. Classification is strong (C+) when the boundaries between Biology and other subjects are not firm. Concepts from other subjects are used in Biology though Biology still maintains its identity. Classification is weak (C−) when Biology is not easily recognised from other subjects, when different subject concepts are used

within a Biology class to such an extent that it makes it very difficult to recognise the subject being taught in that particular classroom.

Intra-disciplinary classification focuses on the relationship between different topics within Biology as a subject. If there is no link between different topics i.e. if there are firm boundaries between topics, classification intra-disciplinary is very strong (C++). It is strong (C+) if topics are related somehow. Intra-disciplinary classification is weak (C−) if topics are interlinked.

Inter-discursive classification focuses on the relationship between the school code/the elaborated code (i.e. universal language that is normally learnt at school) and the community code/restricted code (i.e. everyday language which is context based and local) (Bernstein, 1996). Inter-discursive classification is very strong (C++) when the everyday language or community code is not accepted in a classroom situation. In other words, when only the school code is used, classification is very strong. Inter-discursive classification is strong (C+) when the community code is occasionally used to explain something or to build onto it, for example, in order to make it easier for the learners to understand the new concepts. Lastly, inter-discursive classification is weak (C−) when the community code is seen as equal if not more important than the school code. Here, the classroom activities are dominated by the community code at the expense of the school code. This is when the teacher accepts everything and anything said by the learners. An example of this was when many teachers misinterpreted OBE by saying that there are no right or wrong answers.

Framing focused on the relationship between the teacher and the learners within the classroom. Emphasis was placed on **the selection, sequencing, pacing, hierarchical and evaluation** of teaching/learning.

Selection focused on the choices concerning what needed to be done during a particular lesson, how the work was sequenced i.e. who between the teacher and the learners made choices on how to sequence the chosen piece of work to be done? Pacing looked at the time frames for a given task. Who determined the time frame for each task? Was the work learner paced or teacher paced? Hierarchy, in this case, focused on the relationship between the teacher and the learners, i.e. was it positional or personal? Did the teacher share her space with the learners? Assessment rules were looked at in terms of how the learners' tasks were marked. Were the learners given feedback on their performance? Were

the learners aware of what was expected of them when given a task to do? Was there any remedial work done or were learners given some guidelines regarding their expected performance? In short, framing relationships checked whether teaching and learning was teacher-centred or learner-centred. Weak framing (F−) means that classroom activities are learner-centred and very strong framing (F++) meaning that classroom activities are teacher-centred. If framing is just strong (F+) it means that there is a combination of very strong framing and weak framing. The activities are based on both the teacher and the learners. If I were to use a continuum of very strong framing and weak framing, strong framing would be at more or less the centre of the continuum.

Conceptual count was used to check the classification relationships as well as the knowledge hierarchies. Concepts used in each lesson were listed. Next to a term that was used more than once, a number was written to indicate how many times the term was used over the five lessons. The following term needs further definition if the idea of a conceptual count is to be understood:
'**Concept**' refers to an abstract or general idea inferred or derived from specific instances.

This definition was used in order to identify the link between lessons (intra-disciplinary classification). The concepts were further categorised in terms of Biology content and skill. On the conceptual count table, next to each term, a letter (C), meaning content, or a letter (S), meaning skill, was written. All this information from the conceptual count table helped in analysing the data according to knowledge hierarchies. Knowledge hierarchies were divided into **three categories** namely:

1. **Control** - the teacher was taken as the main source of information, what the teacher says goes. The learners depended on the teacher's approval when doing their work. Correct answers came from the teacher.

2. **Context** – this is an extensional hierarchy. Drawings or books served as the source of valued information. Here, learners depended on their books or notes as a source of information. Learning was based on these contextual factors without which no learning could take place.

3. **Intensional** - where teaching and learning is based on the structure of Biology knowledge itself. Here, the teacher makes intensional decisions on what to teach and how to teach it i.e. the teacher is guided by overarching concepts in her selection, sequence and pacing of the lesson. Knowledge hierarchies are closely linked with the recognition and realization rule

achievement. In other words, recognition and realization rules are achieved in terms of context, control and content.

The study checked whether these rules have been achieved in all of the three mentioned knowledge hierarchy categories.

In analysing the data collected, framing and classification tables were compiled and analysed with comments to give a clearer picture. Lessons and interview transcripts were analysed in terms of framing and classification relationships, conceptual count and knowledge hierarchy. The findings from these analysed data then formed the heart of this study.

When comparing this study with similar studies in this field, the findings of this study partly support the findings that were made by Hoadley (2005) in her study where she compared middle class and working class schools. It became clear that in our working class schools (i.e. schools from poor socio-economic communities) there is a lack of intensional knowledge hierarchy in teaching. Both teachers and learners show signs that they have not achieved the recognition and realization rule when it comes to subject content. Parker (2004) investigated the tensions raised by the question of what is meant by a 'competent teacher' and what kind of knowledge(s) and practice(s) teachers should acquire and how these should be acquired.

She found that there could be a lot of activities going on within the classroom when viewed externally, but the moment the analysis is done internally, clear signs of the lack of substance (intensions) emerge. This is similar to what Adler (2000) refers to a 'deficit discourse', which is being (re) produced unintentionally in current teaching practice as a result of curriculum reform and the aftermath of apartheid education. Adler (2000) argues that teachers' practices are influenced by the context in which they are situated. Their patterns of practice might therefore be the mechanisms they use to cope with a given situation. Obviously any interpretation of learning and teaching needs to be an interpretation of the inter-related process concerning who is learning and what is being learnt in what ways in what contexts.

CHAPTER THREE

LITERATURE REVIEW

In this study curriculum is viewed as everything that learners learn through their school experiences, i.e. the written and unwritten curriculum as well as the explicit and implicit curriculum (Schnorr, 1989). Curriculum is understood as including all activities (formal and informal) designed for the holistic development of a learner. According to Page & Page (1993) it is important to understand the problems that might threaten the emotional well- being of a learner wherever these problems occur in the curriculum. This understanding can influence the teacher-learner relationship in the classroom (which is my unit of analysis).

Since I will be looking at teacher-learner relationships in the classroom, it is important to mention what is expected in the classroom. According to Ainscow & Tweddle (1988) teaching needs to be characterised by a sense of purpose. Whatever the teacher says or does must be purpose driven. This obviously requires a well - qualified, informed or experienced teacher in his or her field. Jansen (1999) believes that the professional development of teachers should aim at the learning gain. So in-service training of teachers should aim at improved learner performance, for example. This is in accordance with the view that science is a strongly classified discourse, to use Bernstein's concept, meaning that its knowledge is well separated from other discourses. Adler (2000) argues that learning depends on the individual learner with his or her history and changing identity. This means that though teachers' qualifications are important, learners themselves come to school with their own histories that might impact negatively or positively on their learning.

In South Africa the curriculum reform was a response to a call for an education reform that would address the imbalances of the past. The sequence of events concerning this curriculum reform was described in Chapter 1. The following diagram (adapted from Graven, 2002) summarises the curriculum changes in South Africa:

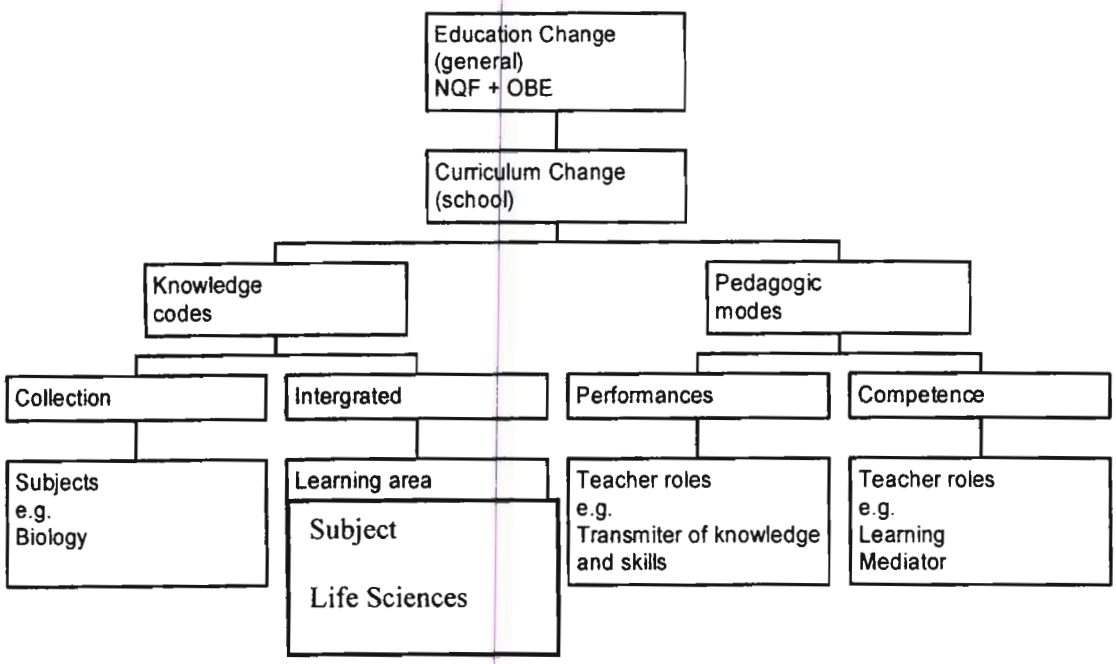

Table 1. A diagrammatical summary showing a change of curriculum in South Africa from the 1996 Interim Core Syllabus (ICS) to 2003 National Curriculum Statements (NCS).

This diagram shows how curriculum has changed from the 1996 ICS for grades 10-12 Biology to the 2003 NCS for grades 10 – 12 Life Sciences to be implemented in 2006 at grade 10. This change originates from the National Education Department and it is informed by the constitution of the democratic South Africa. The aim is to correct the imbalances of the past. As the curriculum was used to separate South African people according to race, it can be used to unite them. (Harley & Wedekind, 2004).

The change is on both the subject content (knowledge code) and the teaching practice (pedagogic mode) at the school level. In this case the subject is Biology that according to the ICS is classified as a collection, meaning that the subject is well separated from other subjects. It has its own language that is not equally useful in other subjects. This diagram shows a change from a collection code where a subject is called Biology to an integrated code where the subject is called Life Science. Pedagogic mode has change from performance to competence. This affects the teacher's role that changes from being the transmitter of knowledge and skills to that of being a learning mediator. The diagram shows how Biology knowledge has been reformed from collection code (singular) to integrated code (region). This is coupled with a change of pedagogic mode from a performance model (teacher-centred with the

teacher as transmitter) to a competence model (learner-centred with the teacher as facilitator or mediator) Graven (2002).
Although this appears to be a neat change when presented on paper, the practice can be somewhat messier. It is difficult for teachers to be facilitators in classrooms that are overcrowded and have limited resources.

Intensive South African research has been conducted around curriculum change concerning Curriculum 2005 and the National Qualifications Framework (NQF). A number of researchers have tried to describe and critique Curriculum 2005 (Harley & Wedekind, 2004; Jansen, 1999) amongst others. Ensor (2004) described Curriculum 2005 and the NQF's emphasis on the mixed curriculum (hybrid) model 'at the expense of vertical progression and mastery'. Ross, 1999 in Ensor (2004), believes that learners are disadvantaged by what seems to be a 'learner-centred' and 'relevant' curriculum that tries to eradicate the difference between academic and everyday practices. This over-emphasis on integration can inhibit the induction of learners to subject knowledge (Adler, Pournara & Graven, 2000). Adler (2000) further argues that learning is not restricted to teacher-learner interactions, but is bound into social relations and relations of power.

Harley & Wedekind (2004), point out that Curriculum 2005 is in close alignment with political vision. If in the past the curriculum was used to divide people according to race and gender as well as prepare them for dominant and subordinate social positions, then the curriculum must also be able to unite them now. Harley & Wedekind (2004), also state that the South African Curriculum reform had to follow clearly defined steps which included the integration of different education departments, the removal of racially offensive, sexist and outdated content from the syllabi while waiting for the new Curriculum, and the introduction of continuous assessment in schools. In 1997 Curriculum 2005 was introduced. As explained above, it was based on three features – it was learner-centred with an outcomes-based and integrated knowledge system (Sayed & Jansen, 2001). Assessment had to be changed from being norm referenced and summative that was judgemental and compared learners against one another to criterion referenced and formative that is developmental (Mseleku, 2002; Muller, 2004; Taylor, 2002; Taylor, Muller and Vinjevold, 2003).

Dowling & Brown (2004), conducted a study in three South African schools. These schools differed in their constructs and contexts in terms of who the teachers were, who attended, the school's resources as well as the ethos of the school. Siyafunda was a school for Blacks, Protea was a school for people of

mixed race and Mont Clair was a school predominantly for Whites. Each school operated differently from the other schools. I can partly identify my study with Dowling and Brown's findings at Siyafunda. The school in my study is situated in a Black township, but it was better resourced than Siyafunda. Sadly though, most of the resources that were once there are now missing due to robberies and vandalism. Interestingly, findings show a similar pattern especially in African Schools (Mouton, 2001), even my findings (as explained in Chapters four and five) are similar in some ways to what others have found. My study falls within this broader South African context, but focuses on a specific subject - Biology in grade 10.

Biology as a school subject or discourse falls under the science department. Science is commonly considered to be an example of uncontested knowledge. Science subjects are usually strongly classified and framed (Donnelly, 1996). An example of strong classification and framing occurred with The National Curriculum Science Working Group (1987) where a programme of study that provided a detailed description of the content, skills and processes to be taught to all learners as well as time frames was produced. This type of school of thought views curriculum as a blue print where teachers are supposed to follow the instructions set out in the national curriculum statements. Our South African curriculum statements for grades 10-12 seem to follow the same pattern. This is evident in the KZN Biology Interim Core Syllabus and Provincialised Guide of 1996. This curriculum policy is strongly framed from the curriculum designers to the teachers, as the results of policy document analysis will show.

This study is aimed at investigating its implementation, focusing mainly on the teacher-learner framing relationships as well as on what the worthwhile knowledge is in Biology, though this is a secondary question as explained earlier on. According to Dempster and Hugo's paper (2006) "evolution is the highest ordering principle in Biology" that can prepare learners for tertiary education and make them enlightened citizens (Dempster & Hugo, 2006). They argue that our South African Biology curriculum before year 1994 did not include this principle because it contradicted with the Christian belief of the government of that time. They further argue that even the current curriculum statements do not have the principle 'evolution' though they contain concepts that relate to evolution. Although different concepts are focussed on, my study found something similar, namely that intensional understanding of the subject was weak especially with the learners. This might be the main cause of the problem that I identified in my study that the gist of the subject is missing. Hence it is very difficult to identify what is considered to be the worthwhile knowledge in Biology using the lessons that I observed.

Mayr (1997) argues that Biology is a diverse field of study that is structured around three questions namely: 'What'; 'How' and 'Why'. This means that Biology teachers might teach only the Descriptive Biology that answers the 'What' questions, if they consider this to be the worthwhile knowledge. Others might teach the Functional Biology that answers the 'How' questions depending on their understanding of the worthwhile knowledge in Biology. The 'Why' questions are the highest questions that explain the causes for structures and functioning of the living organisms (Dempster & Hugo, 2006). Biology as a discourse should be taught holistically. All three questions should be answered when Biology is learned. Unfortunately, the lessons that I observed show that Biology is taught at a descriptive level i.e. answering only the 'what' and ignoring the other two questions.

According to Woolnough (1994), though science subjects are strongly classified and framed, seen as being too prescriptive, too impersonal, too lacking in opportunity for personal judgement and creativity, context independent and driven by national curriculum and examination syllabuses, they can be taught in an exciting manner when they are approached holistically. Though there are a number of factors that might influence the teacher-learner framing relationships, Huff (1993) highlights the importance of community or restricted code (the everyday knowledge) in teaching and learning in his consideration of how the underlying cultural values of a society and civilisation influence scientific inquiry.

Biology is a hierarchical subject that is arranged vertically (Bernstein, 1996). When looking at its policy document, I discovered that as the learners move up the pedagogical hierarchy, abstraction increases in complexity. At lower grades, for example, learners in human anatomy learn about the whole body as an organism. This is concrete as they can see their own bodies and its different parts. As they go further up the pedagogic hierarchy, they study cells and their composition, which is very abstract. Theories of hierarchy will help in explaining these movements during classroom observations. These theories have been fully explained in the Theoretical Framework section.

Knowledge can be researched as vertical discourse or horizontal discourse (Bernstein, 1996 in Ensor, 2004). In vertical discourses, the emphasis is on school knowledge as opposed to everyday knowledge. Subject knowledge, which is conceptual and context independent, is valued more highly. The reason for this is that this kind of knowledge is elaborated i.e. it applies across context. The transmission and acquisition can either be explicit or implicit but it always has purposeful intensions. It has a symbolic

mastery (Bernstein, 1996). The vertical knowledge discourse can be divided into hierarchical knowledge structures and horizontal knowledge structures.

The subjects that are classified as having hierarchical knowledge structures are Biology and Physical Science (a hierarchical knowledge structure means that the concepts within the subject build upon one another i.e. the second topic within the subject builds upon the first topic and the higher grades in the pedagogic hierarchy build upon the lower grades. This means that if a learner skips a grade (for example passes grade 10 and goes to grade 12) he/she will not be able to understand what is going on in that grade for that particular subject. There will be a knowledge gap making it difficult for the learner to recognise the subject. Vertical knowledge structure forms parts that build on other parts into ever more complex wholes (Bernstein, 1999; Muller, 2004). Horizontal knowledge structure means that the subject uses concepts that do not build upon each other but are arranged segmentally (Bernstein, 1999; Breier, 2002; Muller, 2004). This is because these subjects have complex concepts. Maths and Art are classified as having horizontal knowledge structures within the vertical discourse. This is because these subjects have a very strong grammar, according to Bernstein (1996).

Where knowledge has a horizontal structure the emphasis is on everyday, common sense knowledge, which is context bound. It is restricted because it only deals with the life world of the learner. It corresponds with what Bernstein call the community code, as it is local and usually oral in its form. Mastery is usually practical and contradictory across contexts. Learning takes place through tacit pedagogy i.e. teaching and learning by modelling without purposeful intentions. The knowledge in the horizontal discourse is segmental as opposed to the type token tree evident in the vertical discourse.

As I have briefly mentioned, pedagogy in the vertical discourse can be implicit or explicit. I will now explain briefly what is meant by explicit and implicit pedagogy. Explicit pedagogy can be to some extent explained simply as meaning teacher-centred pedagogy where framing is very strong with the teacher deciding what to teach and how to teach it. This is usually associated with strong classification of school subjects and the timetable in the school. Learners are controlled by positional relations to the teacher or to the principal of the school. Implicit pedagogy, on the other hand, is usually learner-centred, as the role of the teacher is not clearly defined. Learner-centred pedagogy is usually associated with the integrated code where classification and framing is weak in terms of school subjects and the timetable. Learner control depends on personal relations between the teachers and the learners.

This explanation of knowledge and pedagogy has led me into explaining the dimensions of school subjects or discourses.

Some school subjects are grouped under the collection code while others are classified under the integrated code (Bernstein, 1996, 1999, 2000; Graven, 2002). The collection code means that the curriculum content is specific to the particular subject i.e. it uses concepts that are specific to that particular subject. The vertical discourses fit very well under the collection code. Classification and framing are very strong and the pedagogy is teacher-centred and subject based. The assessment mode that matters most is objective testing that assesses the cognitive and intellectual competences. The integrated code, on the other hand, means that the curriculum content is based on enquiry activities. The subjects allow concepts from other subjects to be used in their enquiry. Classification and framing are usually weak. Pedagogy is learner-centred. Assessment is done in a number of ways i.e. it takes multiple forms assessing cognitive and socio-affective competences.

I will conclude by saying that this research project tried to get beyond simply focussing on curriculum as exclusively plan or practice. It tried to see plan and practice as interdependent in curriculum research. Researching only the plan will give you a very limited data set. This limited data can be enhanced by researching curriculum as practice, as this can show exactly what actually happens in the classroom. In my research project, I started by looking briefly at the plan although I did not thoroughly research curriculum as plan. The curriculum as plan will inform my research of curriculum as practice. It is necessary to point this out as I have found from my observations that having the curriculum as plan does not necessarily mean that it will be similar to the curriculum as practice as it is supposed to be. When it comes to practice teachers interpret the plan differently. This is why I researched how teachers both understand and implement the Interim Core Syllabus.

Similar studies that looked at the curriculum either as plan or as practice have been conducted here in South Africa. One conducted by Hoadley (2005) compared teachers from working class schools with teachers from middle class schools in an investigation of whether teachers act as interrupters and amplifiers of the community code and school code respectively. The findings showed that teachers from middle class schools do act as amplifiers of the school code and interrupters of the community code. On the other hand, teachers from the working class schools seemed to be the amplifiers of the community code instead of being the interrupters of this code (Hoadley, 2005). Here curriculum was

researched as practice as the focus was on what teachers were doing in their classrooms. The focus was similar to the focus of my study and the findings are similar.

Another study, conducted by Bertram (2005), compared curriculum policies. She compared the History Interim Core Syllabus (ICS) of 1996 for STD 8-10 with the History National Curriculum Statements of 2003 for grades 10-12. The findings were that these two policies were structured differently. The NCS presents History as an integrated discipline, showing a weaker classification in both intra-disciplinary and inter-discursive classification than the ICS. In my study, a similar comparison has been done and the findings are similar. The impact of the NCS will depend mostly on how History teachers \ Biology teachers understand and implement the policy in the classroom. Depending on the teachers' knowledge and skills in managing the new curriculum, learners might benefit or be disadvantaged by the new curriculum in achieving the realization rule. These studies show the importance of the teacher in the implementation of any educational reform (Adler, 2000).

It is my hope that when teachers are trained or when they attend workshops on the implementation of the FET curriculum, the central concepts of each subject is made explicit to the teachers. This may ensure that whatever teachers do in their classrooms does not leave out the essence of each discipline. This is a challenge to curriculum designers, in-service trainers or facilitators, teachers and those who make or write teaching and learning support materials (Adler, 2000). The findings of other research conducted concluded that in-service programs should focus on subject matter and knowledge as well as teaching behaviours.

Ensor (1999); Ensor & Hoadley (2001), argue that teachers teach in the way in which they were taught. The only difference is that they select lesser tasks and use low levels of specialisation. Ensor (1999; 2004) questions whether teachers, while they were still students, were given the opportunity to develop 'generative principles' or 'recognition and realisation rules' (Bernstein, 1996) to help them recognise the 'best practice' and put it into practice.

A difficulty with a study of this nature is that it relies on a limited community of practice. This can make the literature review narrower and more specialised than is ideal. It is, however, a growing field with all the challenges and opportunities that that entails.

CHAPTER FOUR

POLICY DOCUMENTS AND LESSON ANALYSES

In this chapter an analysis of the two policy documents the 1996 Interim Core Syllabus (ICS) for grades 10-12 currently being implemented and the 2003 National Curriculum Statements (NCS) for grades 10-12 to be implemented in 2006 is briefly described. The analysis of these curriculum statements was adapted from Bertram's (2005) analysis of History curriculum documents. After the description of the analysis of these policy documents, a description and analysis of lessons observed will follow.

4.1. Analysis of Policy Documents

In this analysis the two documents were compared firstly in terms of their physical appearance. Thereafter sentences were coded in terms of classification and framing. This coding of sentences was firstly done by a group of Masters students, of which I was one, in one of the modules done as part of the course work component of the Masters course. The coding was influenced by Morais & Neves' (2001) study of curriculum reform. Sentences were coded as very strongly classified if the subject knowledge was well insulated from other subjects. Classification was said to be weak if the sentence allowed the use of knowledge from other subjects or everyday knowledge within a particular subject (Biology in this case). Framing referred to control - who make decisions in terms of selection, organisation and pacing and timing of knowledge taught and learnt in the classroom? If the teacher makes all the decisions, framing is considered to be very strong and if learners decide on what to do, how to do it and when to do it, then framing is considered to be weak. The focus of the analysis was on coding the sentences that had something to do with framing or classification. Other sentences were ignored.

In analysing their physical structure it is clear that the two documents are structured differently. The ICS is fifty-five pages long. The first five pages covered headings relating to general remarks, the objectives and approach to the syllabus and the syllabus itself, the components of the examination at the end of Grade 12 and the separation and weighting of various topics as well as the formatting of the paper. The next thirty-one pages (pages 6 – 36) are dedicated to the syllabus content to be covered in grades 10 –12 for both standard grade and higher grade.

Fourteen pages (pages 37 – 50) are dedicated to the clarification of the Common Understanding of the Core Syllabus for the National Examination: Grade 12 Biology HG (2001). The last five pages are dedicated to the clarification of the Common Understanding of the Core Syllabus for the National Examination: Grade 12 Biology SG (2001).

For this study the focus was on Grade 8 Biology only. There are six pages that are dedicated to both the Standard Grade and the Higher Grade syllabus. The syllabus simply specifies what must be covered in Biology Grade 8 for both HG and SG.

4.1.1.Analysis of the 1996 Interim Core Syllabus for Grade 10 Biology.

Unit of Analysis = Framing relationships between the teacher and the learner in the classroom under different parts of the document. Framing focuses on the relationship between the teacher (transmitter) and the learner (acquirer) within the classroom in terms selection, sequencing, pacing and evaluation. "Where framing is strong, the transmitter has explicit control over selection, sequence, pacing, criteria and the social base" (Bernstein, 1996). Framing relationships between the teacher and the learner are weak, i.e. all the seven statements under the heading 'Objectives of the Syllabus' listed below, focused on what the learner should be able to do.

4.1.2.Objectives of the Syllabus. An ability to analyse and evaluate biological information, to formulate hypotheses and suggest procedures to test them.

- An ability to communicate clearly when reporting information and expressing ideas.
- A respect for all living things and an urgent awareness of man's responsibility in the presevation of life, particularly in the South African context.
- A love and appreciation for the South African fauna and flora and a recognition of the urgent need for nature conservation.

Under this heading there were seven statements that focused on the framing relationship between the learner and the teacher. All seven statements focus on what the learner should be able to do. They explicitly state what the learners should achieve at the end of the learning experience. This means that the framing relationships between the teacher and the learner are weak, but the teacher's role is implicit. The document does not say what the teacher should do. This example is curiously difficult to analyse once one gives it some thought, for there is still strong framing, only now it is between the

learner and the actual syllabus, with the teacher being left out of the equation. I would suggest that behind this simple omission lies one of the bigger mistakes of the reformed curriculum statements.

Approach to the Syllabus.

There are four statements namely:

- Pupils should make their own observations of specimens and experiments.
- Pupils should learn how to handle and set up apparatus correctly
- Organisms should be observed in their natural environments
- Constant emphasis should be placed upon facts being understood, interpreted and applied rather than being merely memorised.

All four of these statements show weak framing as the focus is on the learner. It is learner- centred and the teacher's role is implicit. It is assumed that the teacher knows what to do in creating this environment where learners will be able to do what is stated in the above statements.

4.1.3.The Syllabus and Assessment.

There were seventy statements under this heading and all of them show a very strong framing relationship between the teacher and the Department of Education. The syllabus design is clearly explained and assessment is clearly specified. The number of exam papers to be written is stated as is their sequence as well as time frame. There is a clear distribution of topics to be covered and their weighting. This gives the teacher guidelines as to how much time should be spent on each topic.

4.1.4.The Syllabus – Elaboration HG and SG.

The syllabus lists all the topics and their depth to be covered at grade 10 level. See appendix 3 for details. Both the teachers and learners' roles are implicit, but there is very strong framing from the Department of Education to the teachers. Topics to be covered are clearly explained; even the teaching methods are sometimes suggested, for example learners are to conduct a survey of a particular ecosystem in order to find biotic and abiotic components. There are a number of subject specific concepts that need to be explained by the teacher before learners can understand them. This calls for a very strong framing relationship between the teacher and the learners (F++). Even when learners are

given a task or project to do (F-), there are clear instructions given in order to guide the learners' activity (F+).

4.1.5.The National Curriculum Statements

The National Curriculum Statements' physical structure is different, as mentioned earlier. They consist of four chapters in sixty-five pages. Chapter One is an introduction to the NCS. It describes the principles and design features of the National Curriculum Statement Grade 10 – 12.
Chapter Two introduces the subject by describing the definition, purpose, scope, career links and learning outcomes of the subject. Chapter Three contains the learning outcomes, assessment statements, content and contexts of the subject. The assessment standards are arranged in such a way that they show the intended progression from grade 10- 12 in Biology. The proposed content and context to be taught and learnt is listed. Chapter Four deals with the approach to assessment. The competence descriptions, codes and scales are provided for each grade and are arranged in an order that demonstrates progression from grade 10 – 12.

There are three learning outcomes for all the grades, i.e. grade 10 to grade 12. These learning outcomes are the same for all the grades. Each learning outcome has many assessment standards as well as examples that can help the teacher know when the learner has achieved that particular assessment standard. Assessment standards differ from grade to grade. To illustrate this, I will use one example by taking learning outcome number one and seeing how the assessment standards differ from grade to grade. The learning outcome is entitled 'scientific inquiry and problem solving skills'. This means that the learner should be able to "confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills". The first assessment standard - "identifying and questioning phenomena and planning an investigation" is the same for all the grades but the assessment criteria differ for all grades in level of complexity of knowledge. So for grade 10 learners must be able to: (these are the assessment criteria)

- Identify and question phenomena.
- Plan an investigation using instructions
- Consider implications of investigative procedures in a safe environment.

Grade 11 learners must be able to:

- Identify phenomena involving one variable to be tested.
- Design simple tests to measure the effects of this variable to be tested.

- Identify advantages and limitations of experimental design.

Grade 12 learners must be able to:

- Generate and question hypotheses based on identified phenomena for situations involving more than one variable.
- Design tests and/or surveys to investigate these variables.
- Evaluate the experimental design.

This learning outcome and its assessment standards and assessment criteria are taken directly from the Department of Education's (2003) National Curriculum Statements for Grades 10 – 12 Life Sciences. The example clearly shows how the curriculum statements intend to make the learners' achievement of learning outcome develop in complexity as the learners ascend the skills hierarchy.

Coming back to grade 10, as I have explained there are three learning outcomes for Life Sciences (Biology) grade 10. For learning outcome one, as explained above, there are three assessment standards. The first assessment standard is further broken down into three assessment criteria with examples. E.g. Assessment criterion number 1. Identify and question phenomena: attainment is evident when a learner, observe that some pot plants are growing poorly and questions whether they are lacking a mineral salt. The second assessment standard is broken down into two assessment criteria with examples to help the teacher assess whether the learner has achieved the learning outcome and to what extent he/she is doing so. The third assessment standard has one assessment criterion with examples. See appendix 4 for more details. This learning outcome is coded as very strongly framed externally i.e between the teacher and the curriculum designer. It is a s weakly framed internally i.e. between the teacher and the learner, though the teacher's role is implicit. The framing relationship between the teacher and the curriculum designer is very strong, yet it is weak between the teacher and the learner. It is the same for all three learning outcomes. (see appendix 4 for further details)

For the second learning outcome "construction and application of Life Science knowledge", the learner should be able to access, interpret, construct and use Life Sciences concepts to explain phenomena relevant to Life Sciences (Department of Education, 2003.) There are three assessment standards. The first assessment standard is broken down to one assessment criterion with an example. The second one is broken into two assessment criteria with examples and the third on has one assessment criterion with an example.

For the third learning outcome, "Life Sciences, Technology, Environment and Society", the learner should be able to demonstrate an understanding of the nature of science, the influence of ethics and biases in the Life Sciences, and the interrelationship of sciences, technology, indigenous knowledge, the environment and society. For this learning outcome, there are three assessment standards each with one assessment criterion and an example.

After the explanation of learning outcomes and assessment standards, the policy statements continue with an explanation of the content and the context for the attainment of the assessment standards for each learning outcome. This explanation is nine pages long because it is explicit and detailed. The next twenty pages explain assessment in full detail. This section starts with reasons for assessing then moves on to types of assessment, what assessment should be and do, methods of assessment, methods of collecting assessment evidence, recording and reporting, subject competence descriptions, promotions, what report cards should look like, assessment of learners who experience barriers to learning and competence descriptions with codes and scales for achievements. The last three pages are dedicated to a glossary of terms used in the document.

The following are the analysis tables in terms of classification and framing. 'Internal' (i) refers to the relationship between the teacher and the learner while 'external' (e) refers to the relationships beyond the classroom which impact on the classroom. I did the analysis after doing examples with my supervisor and Master's colleagues, after ensuring that the criteria were clear with examples. The following analysis is my own analysis. See appendix 3 for details.

FRAMING CODING OF the 1996 Interim Core Syllabus for grade 10 Biology.

Uncoded statements	F++	F+	F–	F++e F-i	F+e F-i	F++e F+i
75	0	0	0	47	4	0

Table 2.

According to the ICS table, table 2, framing relationships between the teacher and the learners are implicit in the Interim Core Syllabus (see appendix 3). Seventy-five statements could not be coded in terms of framing. Forty-seven statements were coded as very strong external framing and weak internal framing. This means that the instructions from curriculum designers (department of education) to

curriculum implementers (teachers) are explicit. Nothing is said about the teacher-learner framing relationship.

The following tables show three different types of classification relationships, namely:
Inter-disciplinary,
Intra-disciplinary and
Inter-discursive relationships.

Inter-disciplinary classification focuses on the relationship between Biology and other subjects, looking at the boundaries between Biology knowledge and procedures and those of other subjects. Classification inter-disciplinary is said to be very strong (C++) if the subject is unique, using only its own concepts. The following is an example of a very strongly inter-disciplinary classified statement from the ICS. "An understanding of fundamental biological principles based upon a study of living organisms" (Interim syllabus for Grades 10,11 and 12 Biology).

Strong inter-disciplinary classification (C+), means that the boundaries between Biology and other subjects are firm. Concepts from other subjects are used in Biology though Biology still maintains its identity. Example from the ICS: "Abiotic components which might be investigated include: light, length of the day; temperature; water, including water cycle; atmospheric gases, including winds; soil characteristics such as pH, acid content, humus content, texture, water-holding capacity and air content; aspect, slope and altitude".

Weak inter-disciplinary classification (C-), means that Biology is not easily recognised from other subjects. terms from other subjects are used within a Biology class to such an extent that it makes it very difficult to recognise the subject being taught. Example from the ICS: "A variety of objective type questions will be set. Examples of such questions will include: multiple choice; correct biological terms, matching columns; filling in blanks; item/statement; labelling of diagrams; data response; comprehension passages; graphs and tables".

Intra-disciplinary classification focuses on the relationship between different topics within Biology as a subject. If there is no link between different topics, classification is very strong (C++). It is strong (C+) if topics are related, and weak (C-) if topics are interlinked. ICS show a very strong intra-disciplinary

classification. Example of different topics for paper one from the ICS: "Biological compounds; enzymes and co-enzymes; Photosynthesis and Population dynamics".

Inter- discursive classification focuses on the relationship between the language that is normally learnt at school (school code) and the everyday language (community code). Inter-discursive classification is very strong (C++) when everyday language is not accepted in a classroom situation. It is strong (C+) when the community code is used occasionally, and weak (C-) when the community code is seen as equal if not important than the school code. Only one statement was coded C+ and four statements were coded C-, no statements were coded C++. Example from the ICS of a weakly classified statement: "Organisms should be observed in their natural environments".

CLASSIFICATION CODING OF the 1996 Interim Core Syllabus for grade 10 Biology.

Inter-disciplinary – Biology and other subjects

Uncoded	C++	C+	C–
38	71	2	3

Table 3 a

Intra-disciplinary – within Biology

Uncoded	C++	C+	C–
	54		

Table 3 b

Inter-discursive = Biology and everyday local knowledge

Uncoded	C++	C+	C–
		1	4

Table 3 c

The tables (3 a-c) show very strong classification. Though there are thirty-eight statements that are not coded, one hundred and twenty-five statements show a very strong classification i.e. if inter-disciplinary classification (71) is added to intra-disciplinary classification (54). Another disjuncture is that of framing. While the policy document does not say anything about teacher-learner framing relationship, the teacher interpreted that as very strong framing. This is shown in her practice during the lessons that were observed. The lessons were teacher centred though learners were sitting in groups. The teacher decided what needed to be done, when, how, by whom and for how long. Lastly, the policy

document analysis shows weak inter-discursive classification, though only five statements were coded in this category i.e. one C+ and four C-. (see appendix 4).

The following tables illustrate the framing and classification relationships contained in the National Curriculum Statements. Coding of statements showing framing and classification relationships in the NCS is the same as the one used in analysing the ICS.

GRADE 10 (2003)

FRAMING RELATIONSHIPS BETWEEN TEACHER & LEARNERS OF NATIONAL CURRICULUM STATEMENTS (NCS) LIFE SCIENCE

Uncoded	F++e	F+	F–	F*	F++e F–i	F+e F–i	F++e F+i
		62	30	1	14	35	52

Table 4.

CLASSIFICATION CODING OF NATIONAL CURRICULUM STATEMENTS (NCS) LIFE SCIENCE

Inter-disciplinary

Uncoded	C++	C+	C–	C*
	18	11	18	48

Table 5 a.

Intra-disciplinary

Un-coded	C++	C+	C–
	1	7	10

Table 5 b.

Inter-discursive

Un-coded	C++	C+	C–
	0	5	24

Table 5 c.

In conclusion, when comparing the Biology ICS to the Life Sciences NCS, a great difference is depicted between the two policy documents in terms of classification and framing. While the ICS shows no teacher-learner framing relationships, the NCS shows a mixture of strong and weak teacher-

learner framing relationships. Sixty-two statements show strong framing (F+) and thirty statements show weak framing (F-). The differences between the two policy documents are echoed in the classification analysis.

While there were one hundred and twenty-five statements supporting very strong classification in the ICS policy document, only nineteen statements in the NCS supporting very strong classification. Fifty-two statements in the NCS are in line with weak classification, while only seven statements in the ICS supporting weak framing. It will be interesting to see how teachers understand and implement the Life Sciences NCS curriculum to grade 10 learners in 2006

4.2.Description and Analysis of Observed Lessons

A description and analysis of the lessons observed is now presented. The focus is mainly on the lessons observed with a general description of what happened during the five lessons observed followed by an analysis using the language of description. This analysis is further clarified by the analysis of conceptual count and framing and classification tables, which gives a clear picture of what went on in Biology classes.

4.2.1.General Description of the Lessons Observed

Lesson 1

I observed five Biology lessons taught to grade 10 learners, taught by a experienced female teacher. There were about sixty learners in this class. The classroom was designed to accommodate a maximum of forty learners, so the classroom was overcrowded with the teacher and learners having difficulty moving around. The desks were arranged in such a way that learners sit facing each other though they are back to back to other learners. Learners needed to turn their heads sideways in order to look at the board. The teacher spent most of the time standing in front due to the lack of space. When she moved amongst the learners, the learners needed to push their chairs forward and lean against their desks so as to give the teacher space to pass.

In the first lesson learners were requested to draw labelled diagrams of the stem and the root on the board. This was the first question of the activity they had to do. These questions were written on the

board. The lesson started off calmly, but as the learners went forward to write on the board, the classroom became noisy and uncontrolled. The learners all got exited as they went up to the front and soon almost a sixth of the class was up at the board writing.

When the teacher told the learners that their time to write on the board was up, they went back to their seats one by one, slowly giving the teacher control over them. Once everyone had settled down into their chairs, the teacher called up a few learners to mark the diagrams drawn and labelled on the board. If there was something wrong with the diagram or labelling, the teacher assisted the learners to make sure that they knew what they did wrong. To do this she had to redraw the diagram of the stem or root drawn. As there was confusion about the labelling of the redrawn diagram, the teacher requested that the learners list all the tissues they had previously learnt. The learners listed the tissues with assistance from the teacher.

The teacher tried to continue with the lesson, but was put off by a learner who was constantly looking at the camera and not concentrating on the lesson. She reprimanded the learner telling him to participate in the lesson if he wanted to appear in the video. This caused a big distraction in the class as the other learners laughed at the reprimanded learner. The teacher decided to draw the transverse section plan diagram of the stem for the learners so as to move to the next question of the exercise being done. As the teacher drew on the board, the learners were requested to write down the differences between the root and the stem. The teacher then drew a table on the board to list these differences. The teacher then began to call the learners up to the board one by one to write down either a property of the root or that of the stem. The teacher tried to involve as many learners as possible in the lesson by calling them up to the board. The learners laughed at any individual who made an error while writing an answer on the board. As a learner went up to write down their answer, the rest of the learners took down the answers they did not have. Some learners just copied down everything, as they had not done what was requested of them.

After the learners had completed writing down the differences between the stem and the root, the teacher began to ask them what the different sections of the root were made of. The teacher then, after completing the exercise, started a game where the class was divided into two groups, group A and group B. The groups were to alternate between giving the name of the tissue and the function, (i.e. Group A gives the tissue and then group B states the function or purpose of the tissue and visa versa). If a group got an answer wrong, they were marked down. The group that had the most markings against

them would be the losing group. The game began smoothly with the learners swiftly giving the names of the tissue found in the stems of plants and their functions but as it progressed the learners began 'shouting out' answers which irritated the teacher to such an extent that she threatened the learners to take away some assessment marks from the people who spoke out of turn. The game continued and it reached the stage where an argument between the two groups broke out. The noise level in the classroom rose soon dissipated when the teacher intervened. Group A won the game.

The teacher then began handing out pieces of paper to the learners and requested various learners to write the function of the different tissues she had listed earlier. She then asked for the papers back (thirty seconds later) to hand them to different learners so as to mark their answers honestly. The teacher began asking the whole class what the functions of the various tissues were and as the answers came from the learners, the other learners marked their fellow learners' work. The class became loud and restless which caused the teacher to stop teaching and wait for the noise to subside. With the teacher's back turned, one of the learners decided to throw an object to another learner who was sitting across the classroom. The teacher completed writing the answers on the board and wrote up an activity for the class to do for the rest of the lesson. She also reminded the learners about their test that was to be written the following Thursday. The learners were to continue with and complete the exercise by the next lesson.

Throughout the lesson all the learners were enthusiastic but the presence of the video camera distracted them. Whenever the camera lens was pointed at a learner he/she would look into the camera or begin acting in front of it and stop focusing on what the teacher was saying and doing.

Lesson 2

The teacher started the lesson by marking the previous lesson's activity. While the class was marking the work, the teacher put up an over-head transparency to further explain the answers she gave her learners. The teacher then did more revision to further reinforce what the learners had learnt. She then instructed the learners to look at the transparency as they went over the answers. The teacher listed the physical differences between a stem and root after which she gave the answer to the final question of the exercise. Then she asked the learners the functions of the different tissues in roots and stems. After the learners had given her the functions she stated that they would be fine for the test the next day. The learners were then requested to pass their work to the front so that the teacher could mark the rest of the

questions. The teacher also requested that the learners copy down both pictures on the O.H.P and the one on the board and tell her what each diagram represented. A cell phone went off during the lesson, causing a minor disturbance.

The lesson progressed and the usual naming of tissues and structures pointed out by the teacher continued. The learners became more restless and noisy as the lesson went on, but quietened down when the teacher resumed asking them questions about monocotyledonous and dicotyledonous stems as revision for the upcoming test. During the lesson the learners paid more attention to each other instead of the teacher. The learners were given ten minutes to complete an exercise set by the teacher. Most of the learners began doing the work immediately and soon the classroom was quiet and everyone was doing the exercise. For the rest of the lesson the learners continued with the activity with a little assistance from the teacher whenever help was needed. At the end of the lesson the teacher put up what the learners were required to study for their test the next day. She also gave the learners tips on how to spell the biological terms they would write the next day.

Lesson 3

This lesson started on a bad note with the teacher having to repeatedly ask the learners to quieten down. She had to ask the learners six times before they started to be quieter. Once the learners had settled down, the whole class began to mark one another's tests as the teacher told them the answers. The teacher was almost put off by the learners immediately after she began reading out the answers. She had to stop and ask the class what they wanted her to do, as they were not paying attention to what she was saying. The class eventually settled down and the marking commenced. While they were marking the multiple choice section, there was a bit of confusion about one of the questions and the teacher checked to see how they went wrong if they did, and marked their answers. The learners got very excited whenever they got an answer right and always queried a wrong answer. When they moved on to the second question the teacher got angry when the learners asked a question about the tap-root system and told the class that the only reason they might have missed their discussion about the tap-root system was because they were talking, before she threw a piece of chalk at one of the talking learners. This, of course, caused a big disturbance in the class, among the learners. Shortly after this incident another learner cracked a joke that made the whole class laugh and the teacher stopped giving answers to wait for her class to calm down again. The teacher then explained the tap-root system using a drawing to show the primary, secondary and tertiary roots.

The teacher then went on telling the learners that the answers on the board were the only answers there were to the questions that were given. The marking continued and the learners got progressively distracted as they lost interest in what was happening on the board. Some of them began throwing papers at each other when the teacher had her back turned. The teacher had to continuously discipline various learners in her class and had to direct her attention to one learner who was not paying attention and did not know where the rest of the class was when they were marking. She reprimanded the learner and continued with the remaining questions.

Lesson 4

At the beginning of the lesson the learners were all calm and quiet. The teacher could speak without having to raise her voice and all the learners could hear her. The teacher started off by revising some of the work they had previously worked on and learned together. She also listed two new terms for one of the tissues they all had learned before and the learners were quiet and attentive. She then went on to put an over-head transparency with pictures of xylem tissue on it. She explained to them how a drop of water would be transported through the xylem tissue and showed them different types of xylem tissues. The learners were then requested to attempt to draw what a xylem tissue looks like under a microscope by copying the picture displayed on the over-head projector.

The class became noisy again once the teacher said they had to work in pairs. The learners were also given a task that required them to draw the tissues of phloem and label it. The learners started doing their work as soon as they got it. When they had completed the first task, they were given a second task that required them to re-draw a picture of a monocotyledonous and dicotyledonous stem and the way the vascular bundles were arranged in each case. The lesson itself went smoothly and the learners co-operated with the teacher and carried out her instructions to the best of their ability. The fourth task they had to perform was to tabulate the differences between the vascular bundles in a monocotyledonous and dicotyledonous plant. While the learners attempted to complete the tasks they were given, the teacher walked around the classroom and assisted some of her students.

Lesson 5

The class started a new section ('the leaf') in their syllabus. The teacher asked her students to use their knowledge about tissues to tell her about the leaf. They were told to write about the structure of the leaf and were given a piece of A4 paper to write on. They were also asked to draw the structures of the leaf within five minutes. The teacher, after two minutes, then began drawing portions of the leaf on the board as hints for the learners. The learners began to rush their work when the teacher told them they had one minute left. As encouragement the teacher complimented one of the learners on their interpretation of the leaf. The learners got rather loud whenever they had to do group work. They talked too loudly considering that they were not more than seventy centimetres from each other. While doing group work they paid little attention to the teacher and only listened on occasion when the rest of their classmates kept quiet. However during all this commotion they seemed to somehow get their work done efficiently. The teacher then began explaining how the leaf works and what each section of the leaf does during gaseous exchange and photosynthesis.

When interviewing the teacher about her choices and sequence of the lesson, she explained that her plan was influenced by the syllabus. She further explained that in their cluster they emphasised that teachers should teach the related sections of the syllabus at the same time. This allows them to develop in their learners' minds a related bigger picture as they learn further by going into details. What is learnt in a lower grade helps the learners understand better what is learnt in a higher grade. The lessons are sequenced in such a way that the first lesson can serve as a base for next the lesson. This helps to incorporate theory and practice. The teacher explained that one of the lessons that I observed was supposed to be a practical lesson, but due to constraints (i.e. the laboratory being broken into and vandalised), she had to improvise by using an overhead projector as a microscope. She further explained the importance of using the correct biological terms as well as the correct spelling. She said that using incorrect terms or spelling could "cost people's lives" i.e. when these learners are doctors or nurses one day.

In analysing these lessons, I started by breaking the lessons into naturally occurring episodes that could be tracked as activities changed. Appendix 5 provides a relevant example of the transcription. I then listed the concepts used during each lesson. I further placed a number next to a term if it was used more than once over the five lessons. Thirdly I indicated next to each term whether the term represented a skill (s) or subject content (c) as shown on the table below, Table 6. When analysing this table, sixteen content concepts and seven skills concepts were mentioned during lesson one. Of the sixteen content concepts mentioned in lesson one, thirteen were repeated in lesson two. Twelve new content concepts

were mentioned in lesson two. Only three skills concepts were repeated from lesson one. Incidentally, these three skills concepts were the only ones used in lesson two. In lesson three, four content concepts were repeated from lesson one, three from lesson two and ten new content concepts occurred. Three skills concepts were repeated from the previous lessons and three new skills concepts. In lesson four eight content concepts were repeated from the previous lessons, there were nineteen new content concepts and ten skills concepts of which one was repeated from previous lessons. Lesson five consisted of twelve repeated content concepts, thirteen new content concepts and six skills concepts.

When counting these concepts it is clear that there is a link between different lessons and that Biology is a highly specialised conceptual subject. Intra-disciplinary classification is very weak yet the subject as a discourse is strongly classified (i.e. it has strong inter-disciplinary classification). The problem though is that learners did not engage with knowledge beyond recall and repetition, as they were simply mentioning the concepts while labelling the diagrams. Adler & Reed (2000) discovered similar patterns in their study of Mathematics, Science and English. This is clearly depicted in the conceptual count table below, table 6, where (s) labels the item as a skill and (c) labels it as a content while a bracketed number refers to the number of times it has been repeated in the sequence of lessons.

Table 6.

Conceptual Count

17 c	25c i.e. 13r,12n	14c i.e. 4r, 10n	26c i.e. 8r, 18n	25c i.e. 12r, 13n
7 s	3s r	6s i.e. 3r,3n	9s i.e. 1r, 8n	6s i.e. 2r, 4n

Lesson 1	**Lesson 2**	**Lesson 3**	**Lesson 4**	**Lesson 5**
Epidermis (c)	Structure (2) (s)	Remedial work (s)	Vascular bundle (c)	Tissue (5) (c)
Stem (c)	Stem (2) (c)	Accurately (s)	Stele (3) (c)	Microscope (2) (s)
Root (c)	Root (2) (c)	Instructions (s)	Xylem (3) (c)	Root (3) (c)
Tissue (c)	Root hair (2) (c)	Cells (c)	Phloem (3) (c)	Stem (3) (c)
Xylem (c)	Sclerenchyma (c)	Tissues (3) (c)	Sclerenchyma (2) (c)	Leaf (c)
Phloem (c)	Cuticle (2) (c)	Hair like structures (c)	Cambium (3) (c)	Structure (3) (s)
Root hairs (c)	Endodermis (2) (c)	Trichoid (c)	Storage (c)	Functions (2) (s)
Parenchyma (c)	Epidermis (2) (c)	Shoot (c)	Transporting tissue (c)	Shape (c)
Tabulate (s)	Medulla (c)	Seed (c)	Conducting tissue (c)	Characteristics (s)
Diagram (s)	Cambium (2) (c)	Root hair (3) (c)	Laboratory (s)	Apply knowledge (s)
Structure (s)	Rail (c)	Primary root (c)	Solution (c)	Skeletal structure (c)
Differences (s)	Pith (c)	Narditive (c)	Tissue (4) (c)	Palisade (c)
Compare (s)	Root hair (2) (c)	Root cap (c)	Microscope (s)	Chloroplast (c)
Nucleus (c)	Absorption (c)	Epidermis (3) (c)	Stele (3) (c)	Leaf vein (c)
Stele (c)	Stele (2) (c)	Tap root system (c)	Diagram (3) (s)	Longitudinal (c)
Cambium (c)	Protection (2) (c)	Tabulate (2) (s)	Colour code (s)	Tricked cell wall (c)
Endodermis (c)	Dicot (c)	Compare (3) (s)	Stirrup (c)	Stoma (c)
Label (s)	Monocot (c)	Diagrams (2) (s)	Rings (c)	Dermis (c)
Cellular hair (c)	Phloem (2) (c)	Surface area (c)	Tube like structure (s)	Stomata (c)
Cuticle (c)	Xylem (2) (c)	Absorption (2) (c)	Spiral (c)	Gaseous exchange (c)
Transpiration (c)	Compare (2) (s)		Companion cells (c)	Respiration (c)
Protection (c)	Differences (2) (s)		Still tube (c)	Transpiration (c)
Secondary growth (c)	Tissue (2) (c)		Portrait (s)	Dicot leaf (c)
Functions (s)	Circular (c)		Observe (s)	Draw (s)
	Scattered (c)		Specimen (s)	Parenchyma (3) (c)
	Plant tissues (c)		Tissue cells (c)	Chlorenchyma (2) (c)
	Angiosperm (c)		Supporting tissues (c)	Plant tissue (2) (c)
	Anatomy (c)		Chlorenchyma (c)	Cuticle (3) (c)
			Sclerenchyma sheath (c)	Epidermis (4) (c)
			Medulla rail (c)	Xylem (4) (c)
			Cell wall (c)	Cambium (4) (c)
			Parenchyma (2) (c)	Phloem (4) (c)
			Dicot root / stem (c)	
			Monocot root/ stem (c)	

4.2.3.Introduction to the Framing and Classification Rubric

Framing focuses on the relationship between the teacher and the learners in terms of who controls what. As explained earlier, F++ means very strong framing, F+ means strong framing and F– means weak framing.

Hierarchical Relationships

F++ means that the relationship between the teacher and the learners is positional. The teacher is seen as superior to learners and therefore holds a special position in the classroom relationship. In a classroom situation learners do not share spaces with the teacher (Bernstein, 1996; Hasan, 2000; Hoadley, 2005; Morais & Neves, 2001). F+ means that the teacher and learners share spaces during certain parts of the lesson as relationships vary between positional and personal. F– means that relationships between the teacher and the learners are personal and affectionate. In the lessons that were observed, the framing relationships were strong (F+). The teacher and the learners shared spaces during certain parts of the lessons. Eg 1.10. The teacher said, "I want you to come and correct the structures and labels on the root diagram". Learners then came up to the board and made some corrections.

Selection

This refers to who makes choices about the topics or tasks to be done in each lesson. F++ means that only the teacher makes decisions regarding selection, learners have no say. The teacher has full control over selection. F+ means that the teacher makes decisions but learners are also considered. F– means that learners decide on what to do during the lesson. Learners have full control over selection.
(Bernstein, 1996; Hasan, 2000; Hoadley, 2005; Morais & Neves, 2001). In the lessons that were observed, the teacher chose all topics to be dealt with in each lesson. Eg. 2.2. The teacher said, "The work is over there", pointing at the work to be done that was written on the board. This happened at the beginning of lesson two. Therefore framing in terms of selection is very strong.

Sequencing

This refers to the ordering of tasks. F++ means that the teacher makes all decisions on how to do tasks. F+ means that the teacher and learners decide on how to do tasks. F– means that learners make all the decisions on how to carry out the tasks (Bernstein, 1996; Hasan, 2000; Hoadley, 2005; Morais & Naves, 2001). Here the teacher decided on how the tasks were to be done. Framing in terms of sequencing was very strong. Eg. 2.3.At the beginning of lesson two, after showing the learners the

work to be done, she said, "Pay attention grade tens, your work is over there. Let us mark our work, this will take us five minutes. Mark your own work. Use a lead pencil to mark the names of structures of the stem and the root. Once the structure is mentioned, mark it. Root first, hands up. Yes".

Pacing

This refers to decisions concerning time frames given for each task set. F++ means that the teacher gives a strict time limit for each task performed. F+ means that the teacher and learners decide on time allowed for each task. F− means that each learner decides on the amount of time he/she needs to do the task. The lesson is learner-centred (Bernstein, 1996; Hasan, 2000; Hoadley, 2005; Morais & Naves, 2001). Here again the teacher decided on the time frames for each task. In episode number 2.3. The teacher told the learners that the task will be done in five minutes.

Assessment

This refers to decisions about what is accepted as correct, and whether learners know what is expected of them at the beginning or end of the task. It is decisions made about what counts as legitimate text. F++ means that the teacher explicitly tells the learners what is expected and insists that learners do what is expected. F+ means that the teacher decides on what is acceptable and makes it explicit, but learners' answers are also considered. F− means that learners are not told what is expected of them, so learners do not know why their answers are correct or wrong (Bernstein, 1996; Hasan, 2000; Hoadley, 2005; Morais & Neves, 2001). Framing in terms of assessment in the observed lessons, was very strong. In lesson three where a test was marked, the teacher clearly explained how the marking was to be done. Eg. 3.4. and 3.7. of the lesson transcript, the teacher told the learners what was considered as the correct answer. She even told them that there are no other correct answers except those on the board.

Inter-Disciplinary Classification

This defines boundaries between different subjects. C++ means that boundaries between subjects are very strong. Each subject is well insulated from others as boundaries are well defined. C+ means that subjects are slightly weakly insulated from one another. Boundaries between subjects are blurred.
C− means that boundaries between subjects are weak. Subjects are integrated (Bernstein, 1996, 2000; Bertram, 2005; Hoadley, 2005).

Intra-Disciplinary Classification

This defines boundaries between different topics within the subject. C++ means that topics within the subject are well insulated. Each topic is independent. C+ means that some topics are related. C− means that some topics within the subject are interlinked (Bernstein, 1996, 2000; Bertram, 2005; Hoadley, 2005).

For the purposes of this analysis, the lessons have been broken down into naturally occurring episodes. These are referred to under the column 'lesson transcript ref', table 7. (appendix 5 shows how the lessons were divided into naturally occurring episodes. Each statement is given a number e.g. episode1.13 means the 13th statement in lesson 1.

	FRAMING					CLASSIFICATION	
Lesson Transcript ref.	**Hierarchical**	**Selection**	**Sequencing**	**Pacing**	**Evaluation**	**Inter-disciplinary**	**Intra-disciplinary**
1.1-1.103.	F+8, F−5	F+2	F−2, F+2	F++3, F+2, F−1	F++12, F+12	C++	C−
2.1-3.43.	F+2, F++2	F+1, F++1	F+8, F++1, F−1	F+2	F+12, F++3	C−1, C++2	
4.1-4.69		F++, F+5	F+6	F+2	F+8, F++1	C++	C−5
5.1-5.57.	F+2	F+4	F+3	F+2	F++1, F+8	C++	C−
Overall	F+	F+	F+	F+	F+	C++	C−

Table.7.

4.2.4.Comments on Lesson Analysis Tables

The framing relationships in terms of the hierarchy between the teacher and the learners were not very strong because the teacher shared her space with the learners. Learners were allowed to come up to the board and write or draw. The teacher also tried to enter learners' space though it was difficult as the class was overcrowded. Framing was very strong when it came to the selection of work to be done. The teacher decided on the topics for lessons. Learners simply followed the teacher's instructions on what to do. Though framing was very strong in terms of selection, sometimes framing weakened, i.e. when the teacher allowed the learners to draw a structure on the board. It was up to the learners to choose where to start when drawing a particular structure. When drawing and labelling a structure, the sequence framing became weak. The teacher tried to strengthen the sequence framing by telling the learners to work from outside in. She also told the learners to start by drawing the tissues that they knew in places where they were situated and label them until the whole diagram was completed.

Framing relationships with regard to pacing were very strong. The teacher kept on telling the learners how long they had to do a particular activity (see, for example, 1.6. and 1.7. in the lesson transcript). The teacher told the learners that they had one minute to go and later told them that the time was up. The framing relationship was very strong when it came to assessment. The teacher gave the learners a chance to show her what they knew by allowing them to draw the diagrams of a root and a stem on the board, label them and compare the two diagrams by identifying the differences. The learners had to state the functions of the tissues drawn. When they were marking the test, learners were clearly told that there were no other correct answers except those on the board.

Inter-disciplinary classification was very strong. The teacher used biological terms only throughout her lessons. There was a link between topics within the subject so intra-disciplinary classification was weak. An example of this occurred when the teacher started by teaching the learners different structures i.e. the root and the stem. She then went on to teach the learners how to label these structures and explained the functions of each labelled tissue. Later the learners were taught how to compare the different structures by looking at both the differences and similarities.

Throughout the five lessons some concepts were repeatedly mentioned, thus linking all five lessons into one unit. Lesson two and three were closely linked because in lesson two towards the end, the teacher explained what was going to be included in the forthcoming test. In lesson three, the very same test was marked. This is why episodes 2.1 up to 3.43 are written in one column in table 7.

Inter-discursive classification was very strong. The teacher did not allow learners to use their everyday knowledge to answer questions in her class. The teacher insisted on the use of the correct terms and correct spelling. She penalised learners who made spelling mistakes. She told them the importance of writing the correct term and using the correct spelling. Classification within a lesson situation can be divided into two dimensions namely: classification of content and classification of the mode of expression (Dowling, cited in Ensor, 2004).

According to Dowling, in Ensor (2004) these two dimensions generate the following space: There are four domains from which the teacher can operate while teaching. The first domain is called the esoteric domain. Here the use of highly specialised subject specific terms (specialised biological statements) that might be elaborated either as a set of principles or procedures. The second domain is called the expressive domain. Here the teacher use unspecialised language to explain statements that are unambiguously biological in content. The third domain is called the descriptive domain. Here the teacher uses biological statements on non-specialise content. The fourth domain is called the public domain. Here the teacher uses statements that are not biological either in content or in language.

Table 8.

	Mode of Expression	
Content	***Esoteric domain*** Universe of highly specialised biological statements which might be elaborated either as a set of principles (relational) or as a set of procedures (instrumental).	***Expressive domain*** Universe of biological statements which are unambiguously biological in content, but are coached in relatively unspecialised language.
	Descriptive domain Universe of biological statements which appear from the language which they are coached to be biological, but where content is not so. This arises when specialised biological expressions are imposed on non-specialized content.	***Public domain*** Universe of statements which are not unambiguously biological, either in terms of the content that they refer to, or in the language which is used to do this.

Diagram adapted from Dowling (1998 in Ensor,2004).

Considering the above table, in this case study the teacher remained in the esoteric domain that is elaborated as a set of procedures rather than principles. This means that the teacher taught Biology using biological terms only to help learners learn Biology. The teacher did not recruit the expressive domain, descriptive domain or the public domain in helping the learners understand Biology. As a result, learners were tempted or compelled to rote learn without any insight and most of them were able to score high marks on their test.

In analysing the lessons using knowledge hierarchies, the teacher moved freely in all directions. Most of the time the movements were downwards i.e. atomising. She started with the diagrams of the stem and the root. She then broke these down into their simpler tissues, for example root hair for the root and cuticle for the stem. She further explained the functions of these tissues and later compared the two diagrams. Though the movement seemed to be going down i.e. atomising, it was moving up in abstraction since some of these tissues were not noticeable to the naked eye. There was a need for a microscope to view some of these tissues. I can say that the teacher was moving up and down when comparing different structures, for example the stele or the pith.

The comparisons (the discussion of the similarities and differences between the root and stem) were done within the same discipline. There was a lot of self-preservation of Biology as a discipline. Though different diagrams were compared, those diagrams belonged to the same discipline, namely Biology.

In analysing lesson one where learners were required to draw, label and mark the stem and the root on the board, my observation was that everything that went on in the classroom was based on context or control. The lesson depended on the drawings that were made on the board as well as the learners' exercise books where the learners copied the correct drawings. This lesson was also based on control because all the answers given by learners had to be approved by the teacher. Throughout this lesson nothing was based on content intensional hierarchy i.e. learners' answers or activities did not show any understanding of the structure of Biology knowledge. Learners needed to remember what they had seen and if they did not, they copied from their workbooks or textbooks.

During this lesson there were times when the teacher could have elaborated, thus making a content intensional movement on the knowledge hierarchy, but the teacher did not use these opportunities. For example the teacher asked the learners why the epidermis is on the outside. In my opinion, this presented the teacher with an opportunity to move the learners from merely knowing that there was an epidermis on the outside, to understanding the reasons behind it. She looked for a rote answer rather than deeper understanding in her learners. Learners simply memorised the names of the structures with their functions.

In line 1.25 the teacher asked the learners why a particular structure (pointing at it on the board) had root hairs. The answer given by both the teacher and learners was "because this is a root". I think this is an inadequate answer as they were already looking at the structure (root). Intensional movements could have been made here, but the lesson remained context and control-based. Throughout the lesson, learners were highly involved and the teacher was in charge, but it became clear to me that the learners had not yet achieved the recognition rule in Biology. Most of the time learners depended on the teacher for answers.

Seeing that the teacher was making no attempt at intensional hierarchy, I checked the syllabus thinking that perhaps the teacher was following the instructions of the syllabus. I then discovered

that under the approach to the syllabus it is stated that constant emphasis should be placed upon understanding, interpretation and application rather than merely memorising facts (Interim Core Syllabus for grade 10, 11 and 12 Biology, 1996). This means that what was happening in the classroom was contrary to what the policy said should be occurring.

Throughout the five lessons that I observed there were no intensional movements made. Instead, the teacher seemed to encourage rote learning. Learners had to memorise the structures and their functions. Then, when comparing the stem and the root, all learners had to look at the two diagrams and identify the differences by looking at the labels. This classroom practice based all the learning on the contextual knowledge hierarchy meaning that the learners would not know the differences between the stem and the root if these diagrams were removed or perhaps even if only the labels were removed. This shows a lack of recognition rule on the part of the learners. Unfortunately the teacher did not seem to notice that these learners had not achieved the recognition rule.

During the first lesson two learners showed that they were confused. The first learner asked the teacher what he had to write. The teacher had to explain to him before he could write down the differences between the stem and the root, yet the drawings were on the board. This was a sign that this learner did not know what was going on. The teacher could have probed to find out why the learner did not know what to do and then explain further, not simply explain how to see the differences between the stem and the root, but use this as an example to reveal the real structure of Biology knowledge.

As explained earlier, a lot seemed to be happening in this classroom. Learners were busy and noisy, the teacher was often shouting and drawing on the board. This was an active class. The problem only became apparent when the lessons were analysed according to knowledge hierarchy when I noticed that the Biology 'soul' was missing, Adler & Reed (2000) share similar sentiments in their study where South African teachers were observed in three different subjects (Mathematics, English and Science). It was discovered that learners were not enabled to engage with knowledge at anything beyond superficial levels of rote memorisation with its emphasis on recall and repetition.

Adler and Reed's research suggests that the problem may be caused by the 'messages' in current curriculum documents (for example Curriculum 2005) that seem to say group work is 'good' as it helps learners to move from informal spoken language to formal language. I have found, in my experience as a teacher, that the problem lies in the teacher's management of group work. Group work, if not properly managed, can lead to the exclusive use of the community code at the expense of the school code. Sometimes, for example, learners use the time allocated for group work to discuss their own personal issues. Furthermore Bernstein (1996) argues that community knowledge and school knowledge are acquired differently. Therefore community knowledge cannot simply be transferred to school knowledge. Echoing Bernstein are Taylor, Muller and Vinjevold (2003) who point out that over-emphasis of the public domain at the expense of the esoteric domain serves to deny learners access to subject knowledge. Coombe and Davis (1995) share the same sentiment with their belief that the public domain needs to be suppressed to avoid the interruption of pedagogic action.

There is a noticeable lack of movement either from the esoteric subject knowledge down to the everyday world of the learner or from the world of the learner to the subject knowledge in the lesson transcripts. The teacher remained within the esoteric code and did little to enable learner understanding and access. Chapter five focuses on the analysis of both the teacher's and the learners' interviews. A conclusion is drawn from what is discussed in this chapter and Chapter five.

CHAPTER FIVE

ANALYSIS OF QUESTIONNAIRES

5.1.Introduction

In this chapter the questionnaires of both the learners and the teacher will be analysed. Twenty-one learners responded to the questionnaire. As I have explained, these learners responded in writing and they were allowed to use whatever language they found easiest to express themselves. The teacher was given a chance to respond to her questionnaire in her own time. The questionnaires are included as appendices. Learners were asked nine questions and the teacher was asked nineteen questions. The data from the questionnaires are analysed according to hierarchy – context, control and intension. In this instance, context means learners' books and drawings on the chalkboard. Control means positional hierarchy and what the teacher told the learners. Intensional hierarchy focuses on the subject knowledge i.e. on the progressive growth in abstraction. The decision to use these concepts for the final analysis was based on the intention to answer the second sub-question that asks what are the classificatory relationships between Biology and other subjects, between different sections of Biology and between Biology and everyday knowledge. This is what transpired in the questionnaires:

5.2.Internal Analysis of Learners' and Teacher's Questionnaires according to Hierarchy – Context, Control and Intensional

5.2.1.Analysis of Learners' Questionnaire

Learners' responses to the question: Why have you chosen to take Biology in grade 10?

Almost all of the learners said that they chose Biology because it is a pre-requisite for their careers. Out of twenty-one learners, only two learners chose Biology for its own sake i.e. to gain better understanding of Biology as a subject, to gain biological knowledge (intensional hierarchy). These learners stated, for example, "I wanted to know about Biology" and that Biology enabled them to "know the human body and how it functions." These learners did point out that although they wanted to understand the structure of Biology knowledge, they also needed

Biology for their careers. The rest of the learners chose Biology purely for career purposes (context). This could mean that learners do not value Biology knowledge as a worthwhile knowledge in its own right but see it as a means to an en d (i.e. their future careers).

Learners' responses to the question: Do you see any differences in the way Biology is taught and assessed in grade 10 compared to Natural Science in grade 9?

Thirteen out of twenty-one learners said they saw no difference between grade 10 Biology and grade 9 Natural Science. This appeared to be an indication of a lack of the recognition rule as the two subjects are structured differently. To say that there are no differences between the two subjects means that the learners could not recognise either Biology or Natural Science. Some said that they saw the difference was that in grade 9 "we were taught some calculations and in grade 10 there are no calculations". This could mean that learners saw that in grade 9 Biology was combined with Science while in grade 10 Biology is a subject on its own. Some learners said they are "learning more things" in grade 10 while in grade 9 some things were hidden from them. It seems that these learners notice the differences between grade 9 Natural Science and grade 10 Biology based on the degree of complexity (intensional hierarchy).

Learners' responses to the question: What skills/qualities do you think makes a person 'good at Biology'?

Eighteen learners said that one must listen and concentrate on what the teacher is saying in class, work hard at homework and do the activities. Three learners thought that to be good at Biology you must think like a biologist, study, conduct research and understand biological terms (intensional hierarchy).

Learners' responses to the question: What do you think the purpose of learning Biology at school is?

Fifteen learners gave responses such as "I have to know what's inside me and how it functions" and also said that they can "be better when [they] go further with my education," by which they may mean that Biology knowledge could help them in their future studies. It seems, then, that sixteen learners based their responses strongly on context hierarchy and slightly on intensional hierarchy.

Learners' responses to the question: Is Biology generally seen as a "difficult" or an "easy" subject? Why do you think this is the case?

Learners thought that Biology is an easy subject because it deals with their body parts and plants.

Learners' responses to the question: Which subject(s) at school do you think Biology is most similar to? Which subject(s) is Biology most different to? Why do you say this?

All twenty-one learners gave answers that were based on what they see or hear in different classes that they attend. Learners contradicted one another, for example one learner said, "Biology is similar to Science; English and Life Orientation, but different from Maths; Geography; Zulu and Home Economics" while the other learner said that a similar subject is Home Economics and a different one is Zulu. Learners used words or concepts to base their comparisons. If they see or hear a term that is the same as the one they heard in Biology, then they would say that that particular subject is similar to Biology. The subjects that learners classified as different were mostly those subjects that the learners knew very little about because they were not doing them. IsiZulu, Maths and Commercial subjects were commonly classified as different.

Learners' responses to the question: When you were preparing for this test, what did you think you needed to know and be able to do in order to do well in it?

One learner did not respond and twenty learners responded by saying that they needed to learn the labels and their functions, for example "to know how to label the parts" and "everything". This could mean that learners did not know what is demanded by Biology as a subject from them. They just wanted to satisfy the teacher by repeating exactly what the teacher told them, but it is difficult to draw any real conclusions from the limited data available.

Learners' responses to the question: What do you think your teacher expected you to know and be able to do in order to answer the questions?

All responses to this question showed the teacher's superior position in the class. Learners said that the teacher expected them to know everything she told them so that they could pass the test. For example one learner said "She expected us to pass because she even did games with us so we can know and understand. The games were all about what we were going to write". The learner thought that the teacher wanted them to pass or do well in the test. The learners thought that the teacher taught them for the upcoming test. Another learner said, "She would want us to do the easy part first," so that they could do well in the test. These responses highlight what Lave,

(1990) calls "central dilemmas" for teachers in schools where they do not know whether to teach for results or for meaning.

Learners' responses to the question: Do you know why you got full/no/some marks for this test?
Two learners did not respond to this question. Nineteen learners responded by saying that they did not do what the teacher wanted them to do. For example one learner said, "Because I didn't do as she expected me to do". Learners did not give reasons such as "I did not understand a particular Biology content or concepts". Instead they saw the teacher as the sole judge of what they wrote in the test. Learners' responses showed that they did not know that the teacher's judgement should be based on Biology content. It seems as if learners thought that the teacher personally decided on what was correct or wrong.

5.2.2.Analysis of the Teacher's Questionnaire

The teacher decided to become a teacher when her family members and relatives who were teachers influenced her career choices. Another factor contributing to her decision was the fact that at that time teaching was the most popular profession and funding was available making it easier for one to train as a teacher. She 'trained' (studied to become a teacher) for a total of eight years. Initially she trained for two years and obtained a Higher Primary Teacher's Certificate (HPTC). After about seven years of teaching she trained again and obtained a Senior Secondary Teacher's Certificate (SSTC). Two years later she went to the university and studied for four years and obtained a B Pead degree.

When asked whether she enjoyed the training time, the teacher said 'yes' though at times she was frustrated and bored, as she had to repeat the same training when moving from one qualification to the next in the name of 'upgrading'. This alone indicates that there was no content intensional hierarchy in the training of teachers and that there were problems with in-service training that was offered at that time. Teachers continued obtaining higher qualifications without improving or enriching their knowledge base of the subjects they were going to teach. A similar picture transpired in Hoadley's (2005) study of teachers as interrupters or amplifiers of the restricted code.

Though teachers from the working class schools were highly qualified, they did not seem to interrupt the community code or the restricted code but instead seemed to be amplifiers of the community code. I will not dwell much on this topic since this could be a research topic on its own. Adler (2000) has done intensive studies on teacher 'take up' from formal in-service training to see if after attending in-service training teachers change their practices or carry on with the old. Adler found that teachers do carry on with their old practices due to the fact that their context (i.e. their social relations in the school and community) remains the same. Teachers are not given a chance to work under different conditions that might be conducive to the implementation of new ideas obtained from the in-service training. As a coping mechanism teachers continue to do things in a practically possible way considering their situations (Adler and Reed, 2000). In the study conducted by Adler on Mathematics teachers, all those teachers struggled with the content and syllabus coverage, and their learners performed poorly (Adler, 2000). A number of studies show the difficulties that teachers face in trying to implement what they have learnt from workshops or from higher education institutions (Chisholm, 2000; Jansen, 1998; Malcolm, 1999 amongst others).

The teacher in this study has been teaching Biology for more than ten years. As part of her training in the subject she was exposed to all fields of Biology. She enjoys practical work, projects and fieldwork. She said these give the ultimate meaning to concepts. This is an intentional reason. When asked about her aims in teaching Biology, her responses were content based. She said "I aim to establish the relationship each learner has with other living things. I hope that my learners will rise above the mere knowledge of biological facts, but identify problems affecting human nations and embark on scientific research in order to be part of the world's solution to problems". This response is based on intentional hierarchy. It shows that the teacher does understand the overarching concept of teaching Biology. The only problem is that the overarching concept is invisible when one observes the classroom activities. The soul of Biology is missing, so classroom activities become the mere memorising of Biology concepts. Learners were just listing the names of structures and functions without any insight.

The teacher does seem to have achieved the recognition rule of her subject. The problem is with the realization rule. Though the teacher understands Biology as a discourse, she has difficulty in translating her theoretical understanding into classroom practice.

The reasons for this difficulty with the realization rule are not clear. Adler (2000) argues that teachers' practices can be influenced by their context. Perhaps in this case the teacher's practice was influenced by the school's context. In one of the lessons the teacher complained that she needed her Biology laboratory and that it was frustrating having to teach a practical lesson that needs a laboratory in an ordinary classroom using the overhead projector as a microscope. This could be the heart of the teacher's problem with the realisation rule. In addition to this is the possibility that the teacher did not prepare well for her lessons i.e. carefully incorporating content and practice. As a result a lot of activities went on in the classroom that unfortunately left out the Biology content. The teacher went on without noticing that the Biology 'soul' was missing. The result could be learners who know a lot of things but cannot apply their knowledge to different circumstances.

Through the analysis of both the questionnaires and the lessons, it becomes clear that Biology in the case study was like a 'zombie' or the 'undead'. According to Wikipedia, the free encyclopaedia, the 'undead' is a name given to all types of supernatural things that were once alive in a normal sense, died, and then continued to exist in the world of the living. A zombie is among the lower forms of the 'undead'. I equate Biology as a subject or discourse that I observed in this study to a zombie. This is because in the lessons that I observed there were a lot of activities that went on in the classroom but when these activities were analysed, the substance or content or the 'soul' of Biology was missing. This is similar to a zombie that moves around without any purpose, will, or reasoning power, though it can perform some behaviour remembered from its mortal existence. In this study, Biology is seen in this light because a large number of Biology concepts were mentioned in the five lessons but these concepts were simply mentioned without linking them to the bigger picture. The gist or the 'soul' of Biology was missing.

A similar scenario was observed by Adler (2000) where the teacher in the study seemed confident in her teaching. Her learners also seemed confident in their learning. In this lesson learners were engaged in distinguishing the rules of addition and multiplication.

This was at the beginning of the Adler's (2000) study as well as the beginning of the teacher's involvement in a three-year up-grading programme offered by a university. Towards the end of

the programme the teacher was observed again. This time she was defensive and showed signs of being demoralised.

In analysing this scenario I would say that when the teacher was observed for the first time, her teaching practice was context based (procedural). As she continued with her studies, she realised that her teaching ought to be based on intensional hierarchy (principled). She then tried to implement her new realization but her context did not allow her to do this properly. Adler (2000) found that the teacher tried to implement new ways of teaching but the shortages of resources and the social relations inhibited her. The head teacher was ineffectual and undermined the teachers who tried to improve their performance. As a result, the teacher's practice reversed to the old ways. It was now even worse than before because the teacher was now bitter about a number of issues. The same thing could be happening or might have happened to the teacher in my study because this Biology teacher is indeed highly qualified to teach Biology but the school's context might be the stumbling block.

This argument shows that the teacher's practice (instructional discourse) is indeed embedded in the regulative discourse i.e. the social order rules. During lesson observations, it transpired that the school has been exposed to a number of robberies and incidents of vandalism. As a result the school no longer has a functioning Biology laboratory. It is therefore possible that these contextual factors (social order) impacted negatively on the teacher's practice.

My interpretation of what went on in the lessons that I observed is subject to correction. As Adler (2000) argues learning can be influenced by the histories of the learners and their changing identities, bounded into social relations and power relations. When observing these lessons I tried to bracket out my experiences so that my understanding would not be clouded.

CHAPTER SIX

RESEARCH FINDINGS, RECOMMENDATIONS AND CONCLUSION

In this chapter an overview of the whole thesis is presented, findings explained and some recommendations made. This study set out to describe how teachers understand and implement ICS - Biology grade 10. The study forms part of a bigger project that is trying to answer the question "what happens to the reform process as it is translated or re-conceptualised from curriculum statements down to the learners in the classroom". Chapter one gave a background overview of the South African education system. The second chapter focused on the theoretical framework and methodology. Bernstein's theory provides useful concepts to explain what transpired in the data collected. Chapter three located the study in the broader literature of curriculum research. Researching pedagogy is not an easy task since data collection can never be exhausted thus making it difficult to make claims. It is even more difficult to generalise, especially in this study, since it is limited. Related South African literature is briefly explained in this chapter. Chapter four and five focused on data analysis. Chapter four started with the analysis of lessons observed, then followed with the analysis of interview responses by both the teacher and the learners. It transpired here that though there was a lot of activity going on in the classroom, the real substance or the gist of the learning was missing. Learners listed a large number of tissues and their functions without gaining any insight. This was shown by their reliance on the teacher or their books for answers.

Learners recognised that the teacher has higher positional control over them. Some learners said "to be good at Biology, you need to listen to the teacher and do what the teacher tells you to do". One learner said she did not get full marks for the test because she did not write what the teacher wanted. Learners did not base their reasons on the subject content, and they did not know that they needed to understand the Biology knowledge structure in order to be good at Biology.

The teacher, on the other hand, seemed to understand the structure of Biology knowledge. When asked about her aims in teaching Biology she said, "I aim to establish the relationship each learner has with other living things.

I hope that my learners will rise above the mere knowledge of Biological facts, but identify problems affecting human nation and embark on scientific research in order to be part of the world's solution to problems".

The teacher's responses to interview questions created a mismatch between what the teacher was saying and her practice in the classroom. As a result, I have concluded that the teacher has achieved the recognition rule but the problem lies with the realisation rule. It is difficult to pinpoint the cause because the causes could be multiple. It could be that the teacher did not plan very well for these lessons or perhaps the teacher has real problems in applying her knowledge. Other possible causes could be context based as Adler (2000) explained that teachers' practice could be influenced by their contexts.

Though this study is limited, the problems displayed by this teacher could be common among other Biology teachers. If this is the case then teachers need to be helped by informed subject advisors on how to implement the ICS, thus ensuring that the "soul" of Biology is not left out. The main content and principles of the subject need to be made explicit to the teachers during teacher training sessions. Research has shown that teachers teach in the way they were taught. So, if during their teachers' training, they are shown the principles of their subject content, they might in turn show their learners the same principles.

In answering the main question of this study, it appears that the teacher understood the ICS as being teacher centred and strongly classified and framed. As a result the relationships between the teacher and the learners were strongly framed. The teacher selected, sequenced, paced and evaluated the work of the learners. The teacher made choices on what to do; how to do it and how long it should take to do it. During class activities, the teacher kept on telling the learners how much time they had left to finish a given task. At times the teacher counted down from ten to measure the time learners had to complete an activity. When marking the activities, the teacher decided on what was accepted as correct (the legitimate text). When they were marking a test, the teacher explicitly told the learners that there were no other correct answers except those written on the chalkboard. She also insisted on the use of the correct terms and spelling with learners being given half a mark if the spelling was wrong.

The teacher saw Biology as a strongly classified subject with a knowledge structure that is vertically arranged. The teacher insisted on the use of correct biological terms all the time and she believed in linking the lessons. When interviewed and asked about her views concerning the new FET NCS, she said the new curriculum will give learners a better grounding in the subject thus improving their chances in obtaining better matric results since some of the grade 12 work (according to the ICS) now appears as grade 10 work in the FET NCS. This means that the new FET NCS curriculum is bringing enrichment to the Biology Syllabus. She believed that the learners might perform better at the grade 12 final examinations because they would have better grounding as grade 12 Biology content will now be introduced at grade 10. What the teacher did not notice is that the new curriculum might be changing the knowledge structure of Biology from vertical to horizontal. The same kind of work might now be repeated from grade 10 to grade 12, with differences in the level of complexity of the outcomes expected.

It became clear that conceptual understanding of Biology was missing through the five lessons. There were a lot of activities going on in the classroom where learners learnt many biological terms off by heart. They could label the diagrams correctly if the order of the labels were kept the same. Most of the time learners simply copied the correct labels for the diagrams from their exercise books. What seemed to be worthwhile knowledge in these lessons were the names of different parts of the diagrams on the chalkboard and their functions. As was explained earlier, teaching in these lessons was procedural rather than principled. The teacher followed the correct teaching procedures throughout the five lessons. Learners were actively involved in their learning. Learners superficially learnt Biology without any insight. Many of these learners could experience problems when asked to apply their biological knowledge to different contexts.

The findings of this study cannot be used for generalisation since the study is specific and limited, but they could contribute to research since other researchers found similar patterns in their studies. Researchers such as Hoadley (2005); Adler (2000) and Dowling (1993) made similar conclusions, especially about Black schools in the townships. Further research could be conducted in a number of schools from the townships and rural areas. A comparative study could be concluded using this data. The findings from these studies could be used for generalisation as the studies became big enough.

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Appendix One
Questionnaires

QUESTIONNAIRE FOR GRADE 10 LEARNERS: ADAPTED FROM THE INTERVIEW SCHEDULES DESIGNED BY CAROL BERTRAM.

1. Why have you chosen to take Biology in Grade 10?
2. Do you see any differences in the way Biology is taught and assessed in Grade 10, compared to Grade 9?
3. What skills/qualities do you think makes a person "good at Biology"
4. What do you think is the purpose of learning Biology at school?
5. Is biology generally seen as a "difficult" or an "easy" subject? Why do you think this is the case?
6. Which subject(s) at school do you think Biology is most similar to? Which subject(s) is Biology most different to? Why do you say this?

FOCUSING ON THE TEST WRITTEN ON THE 18TH OF MARCH 2005.

7. When you were preparing for this test, what did you think you needed to know and be able to do?
8. What do you think your teacher expected you to know and be able to do in order to answer the test questions?
9. Do you know why you got full marks (or no/ some marks) for this test?

QUESTIONNAIRE FOR THE BIOLOGY TEACHER: ADAPTED FROM THE INTERVIEW SCHEDULE DESIGNED BY CAROL BETRAM FOR THE FET RESEARCH PROJECT AND HER PHD.

BIOGRAPHIC PROFILE

1. Why did you decide to become a teacher?
2. Where and when did you do your teacher training? Did you enjoy this time?

BEING A BIOLOGY TEACHER

3. How long have you been teaching at this school?
4. How long have you been teaching Biology all together?
5. Do you teach any other subject?
6. Why did you choose to teach Biology in particular?
7. What was your experience of learning Biology at school and at College/University?
8. What do you enjoy most about teaching Biology?
9. What do you dislike about teaching Biology?
10. Which subject(s) at school do you think Biology is most similar to? Which subject(s) is most different to? Why do you say this?
11. What do you aim to do when you teach Biology? What do you hope that your learners will get out of learning Biology?
12. Why do you think it is important for children to learner Biology at school?
13. What skills/qualities do you think makes a person "good at Biology"?
14. Do you think learners see Biology generally as a "difficult" or an "easy" subject? Why do you think this is the case?
15. What kind of "status" does Biology have in your school? Why do you think this is the case:
16. What percentage of Grade 9s choose to take biology in Grade 10? What are learners' popular perceptions about Biology?

CURRICULUM CHANGE

17. How do you understand the change that have happened in Biology curriculum recently (either C2005/ RNCS changes or the upcoming FET changes)?
18. What do you think are the purposes of the curriculum changes?
19. As you teach Grade 10, do you have a sense of how the curriculum reform might impact on you teaching assessment next year?

Appendix Two
Questionnaires Response

QUESTIONNAIRE FOR THE BIOLOGY TEACHER: ADAPTED FROM THE INTERVIEW SCHEDULE DESIGNED BY CAROL BETRAM FOR THE FET RESEARCH PROJECT AND HER PHD.

BIOGRAPHIC PROFILE

1. Why did you decide to become a teacher?
   Family influences. Parents all relatives brothers sister are all educators
   Social influences. Teaching profession was popular then. Financial (bursaries) from Department were available
2. Where and when did you do your teacher training? Did you enjoy this time?
   1978-1979 HPTC Eshowe Training College
   1986-1987 SSTC Umlazi Further Education
   1989-1992 STD BPAED University of Zululand
   Yes, it was pleasant and enjoyed all my years of training. It was frustrating though since we has to repeat training in the name of "upgrading" from HPTC to diploma.

BEING A BIOLOGY TEACHER

3. How long have you been teaching at this school?
   I have been teaching for ten years at this school.
4. How long have you been teaching Biology all together?
   I have been teaching Biology for +- 15 years in all.
5. Do you teach any other subject?
   Not at present. I only teach Biology to learners from Grade ten to twelve but I have taught grade 9 before. I also have taught Maths to learners in Grade eight to ten and Geography to learners in Grade eight to ten. While I held HPTC I taught all subjects including B.E., Accounting, History, English and Afrikaans.
6. Why did you choose to teach Biology in particular?
   I had excellent background at High School learning. Excellent Biology teachers, exposure to Lab work. Been motivated and love the subject skills well developed.
7. What was your experience of learning Biology at school and at College/University?
   Experience was perfect, excellent, wide exposure to all fields, good teacher
8. What do you enjoy most about teaching Biology?
   I enjoy the practical work, projects and field- work. I.e. gives ultimate meaning to the concepts. Skills could be used in a wide variety of careers except teaching. (e.g. lab work)
9. What do you dislike about teaching Biology?
   At present I hate the fact that the school does not have resources to aid in teaching making the subject interesting. Also learners seem to be de-motivated and show less interest in learning as a whole.
10. Which subject(s) at school do you think Biology is most similar to? Which subject(s) is most different to? Why do you say this?
    Biology is similar to Home Economics, Geography and Agriculture. Biology is applied in these subjects and where the concepts make sense.
    It is most different to commercial subjects ie Accounting, B.E. Economics. Obviously in money matters and plant and animal matters.
11. What do you aim to do when you teach Biology? What do you hope that your learners will get out of learning Biology?
    I aim to let learners get involved in the subjects. To identify themselves with the concepts, understand their existence as human beings, relate to the dynamics of the subject and give answers to the problem related to their bodies problem and disease. I also aim to establish the relationship each learner has with other living things.

12. Why do you think it is important for children to learner Biology at school?
I hope that my learners will rise about the mere knowledge if the Biological facts, but identify problems affecting human race and embark in scientific research in order to be part of the worlds solutions to problems. Basically Biology is a study of life-concepts that are applicable to their Daily Life. Comparably biology offers a wide variety of interesting and highly paid careers. Have it is a subject that provides advantage.
13. What skills/qualities do you think makes a person "good at Biology"?
Research methodology is essential. Manipulative skills are essential for practical work. To be observant and articulate. Deligence and accuracy. Love of life, nature and nature conservation. Passionate and motivated.
14. Do you think learners see Biology generally as a "difficult" or an "easy" subject? Why do you think this is the case?
Learners think biology is difficult. Misconception! Confuse difficult with lots of work / material to go through. New discoveries keep biology a new subject all the time-concepts change and make biology a dynamic subject. Also biology requires one to know beyond the subject itself.
15. What kind of "status" does Biology have in your school? Why do you think this is the case?
Biology stands as the core of science stream in the school. It is the support subject to three group/streams. It is referred subject in the light of easy 'because less difficult' in comparison with other science subjects namely Maths, Physics and Home Economic. An alternative to other stream e.g. Trade/Bio. As a filled subject Geo/home. Reason interesting, good teachers, resources available.
16. What percentage of Grade 9 learners choose to take biology in Grade 10? What are learners' popular perceptions about Biology?

69% of grade 9 learners choose biology. In my school the focus was to employ highly qualified and motivated teachers. The department is highly committed to the subject. On the history of the school 100% (till 2003) pass rate has been maintained. The subject is popular, it is featured in all streams, either as a choice or compulsory subject.

CURRICULUM CHANGE

17. How do you understand the changes that have happened in Biology curriculum recently (either C2005/ RNCS changes or the upcoming FET changes)?

Changes are for the better. I have always recommended that the syllabus be enriched in the lower grades before learners face their exit examination at high school level. Since Biology is now Life Science, I believe that equipping the learner earlier in life with all the skills is of great impact on the learner's career. The change has been smooth, meaningful and necessary. The change exposes the Life Science as whole to the learner i.e. by the time the learner Grade 10, she/he has been exposed to all skills necessary for scientific approach.

18. What do you think are the purposes of the curriculum changes?

Changes address the needs and the imbalances of the past i.e. shortage of skills in the science field that are a requirement at present.

19. As you teach Grade 10, do you have a sense of how the curriculum reform might impact on you teaching assessment next year?

Teaching is learner-centred and more skills have been added that require the teacher to adjust his/her teaching approach. The syllabus has changed i.e. Grade 11 & 12 content has been included in Grade 10. This ensures that learners gain all necessary knowledge and skills forming the basis for

career choices. For assessment, the tools and methods are the same. When looking at the learning support material, they guide the learning and teaching. They specify what is expected from the learner as well as from the teacher. It supplies a variety of contents based materials that help you on how to test certain skills. It forms uniformity in the teaching and learning thus improving confidence in teaching, knowing what is expected of you.

Appendix Three
Coding Examples of the ICS

Appendix 3. Coding Examples of the Interim Core Syllabus for Biology Grade 10-12 1996.

The document was analysed using the statements as the unit of analysis. These statements were analysed in terms of classification. Classification in this case means control as it is explained in the theoretical framework chapter. Statements were coded according to 1.Inter-disciplinary classification, which focused on the boundaries between different subjects. If a statement is coded as having a very strong inter-disciplinary classification (C++), that means that the subject is completely separated from other subjects. It is well insulated from other subjects, i.e. the subject uses its own terminology that is not applicable to other subjects. If classification is weak (C-), it means that the subject is integrated with other subjects. 2. Intra-disciplinary classification looks at the boundaries between different topics within a subject. If intra-disciplinary classification is very strong (C++) it means that the topics within the subject are independent. They do not build on top of one another. If intra-disciplinary classification is weak (C-) it means that different topics within the subject are interlinked. 3. Inter-discursive classification, which focuses on the boundaries between the every day knowledge (community code) and the subject knowledge (school code). If inter-discursive classification is very strong, it means that the everyday knowledge is not recruited or allowed in a classroom situation. Only the subject knowledge or language is used in the classroom. When the inter-discursive classification is weak, it means that both community code and the school code have equal value in the classroom. Whatever the learner say is acceptable, on the bases that each learner comes to class with some knowledge from his / her background.

Inter-disciplinary classification refers to the boundaries between Biology and other subjects.

C++ - very strong classification means that Biology is well insulated/separated from other subjects. Eg. An understanding of fundamental biological principles based upon a study of living organisms. (ICS 1996)

C+ strong classification means that the boundaries between Biology and other subjects are slightly weakened. Eg. Abiotic components: physical factors, edaphic factors, physiographic factors. Abiotic components which might be investigated include: light, length of the day, temperature, water, including water cycle, atmospheric gases, including soil characteristics such as pH, acid content, humus content, texture, water- holding capacity and air content, aspect, slope and altitude. (ICS 1996)

C- weak classification means the boundaries between Biology and other subjects are weak. Biology does not have specialised concepts. There is no example of this classification since no statement was coded as weakly classified.

Intra-disciplinary classification focuses on the relationship between different topics within Biology.

C++ means that topics within Biology are separated. There are no relationships between what is learned in different sections of the syllabus. Eg. Membranes enclosing cells and forming intracellular partitions: properties, structure and function. Structure: simple fluid mosaic model only. Properties. Functions.

C+ means that different topics within Biology are inter-linked/related. What is learnt in one topic forms the base for the next topic. Eg. Skeletal muscles. Antagonistic arrangement and attachment to bones. A lesson on this topic must be taught after teaching about the Axial skeleton, Appendicular skeleton and the joint structure.

C- Boundaries between topics are weak. Biology is taught according to a number of themes. There are no examples of this classification since no statement was coded as such.

Inter-discursive classification looks at the boundaries between the school code and the community code. Looking at whether learners are allowed to use their everyday knowledge in answering or explaining Biology question/concepts.

C++ means that only Biological concepts are used in answering /explaining Biology questions or concepts. Everyday knowledge is completely separated from Biology as a discipline. Eg. A dorsiventral leaf. External features of a simple leaf; internal structure as seen in transverse section.

C+ boundaries between everyday knowledge and biological knowledge are loosened slightly. Some biological concepts are explained in everyday language. Eg. For practical work a readily available small mammal may be used.

C- boundaries between Biology knowledge and everyday knowledge are weak. Learners are allowed to use their own understanding and background to answer questions. Eg. Organisms should be observed in their natural environments.

Appendix Four
Coding Examples of NCS

Appendix 4. Coding Examples of the National Curriculum Statements for Biology Grade 10 2003. (NCS)

The same coding procedures that were used to analyse the Interim Core Syllabus (appendix 3), were used to analyse the NCS.

Inter-disciplinary classification
Refers to the boundaries between Biology and other subjects.

Very strong inter-disciplinary classification (C++) means that Biology is well separated form other subjects. There is no integration eg. Knowledge in the Life Sciences is constructed and applied within the following knowledge areas: tissues, cells and molecular studies; structures and control of processes in basic life systems. (NCS, 2003)

Strong inter-disciplinary classification (C+) means that though Biology uses its own terminology, it does recruit terms or knowledge from other related subjects. eg. It is important therefore, for learners to understand that other science understandings, such as indigenous knowledge systems, should also be considered. (NCS, 2003)

Weak inter-disciplinary classification (C-) means that the subject is integrated with other subject. The NCS is an integrated curriculum that combines both strong and weak inter-disciplinary classification.

Intra-disciplinary classification.
Refers to the boundaries between different topics within a subject.

Very strong intra-disciplinary classification (C++) means that topics are not interlinked. Each topic can be learned independently. There were no statements that were classified as very strongly classified. Most topics were interlinked. The previous topic serves as a base for the nest topic. Eg. The skills that learners develop and use in Life Sciences cannot be developed in isolation. (NCS, 2003)

Inter-discursive classification
Refers to the boundaries between the school code and the community code. The NCS emphasises that the knowledge that is contested and accepted often depends on social, religious and political factors. (NCS, 2003). The tables therefore shows a weak inter-discursive classification.

Appendix Five

Transcript of lessons observed

Lessons Transcript.

Lesson 1.

1.1. Teacher: A,B (class is divided into two groups, group A and B, teacher writes on the board the two groups.)
1.2. I'm going to point those learners whose hands are not up.
1.3. One structure ……anyone?
1.4. Learner: (after drawing and labelling a structure) olandelayo….next
1.5. Teacher: Next…hey keep quite (referring to a learner who is shouting next, next) give others a chance.
(learners are excited as they write on the board. Each time a learner finishes writing on the he/she calls out, next! next! One learner plays with the chalk pretending to be conducting a choir.
1.6. Teacher: Hey you! Stop, playing. One minute to go. (watching closely what the learners are writing.
(The learners continued drawing and labelling diagrams on the board, the level of noise rises as the two competing groups are typing to finish of their diagrams.)
1.7. Teacher: Time is up. (The teacher takes the chalk away from the learners. The learners go back to their seats. The noise level drops a bit.)
1.8. Teacher: (raising her voice) Right, ok, ok, ok, sit down, sit down and be quiet.
1.9. Teacher: (The learners kept quiet and waited for their results) I am going to give zero to both groups because you cheated. (She wrote the zeros under each group as she spoke...Hawu, the whole class mourned)
1.10. Teacher: (ignoring the class's dissatisfaction) I want you to come and the correct structures and labels on the roots diagram.
1.11. Learner: (sitting at the back, raising her hand) I would like to mark too.
1.12. Teacher: Right…(Giving a piece of chalk to the learner, one learner from each group)
(As the first learner marks the diagram, members of her group are shouting trying to tell which structures are correct.)
1.13. Teacher: (reprimanding the noisy learners) Give her the workbook so that she can look up the answers. (Meanwhile the second learner from group B takes her workbook to the board to mark their diagram)
1.14. Teacher: Wait, wait, wait…(referring to the noisy class, then focuses her attention to the learner marking the diagram, making her (learner) correct her mistakes as she marks. Once satisfied with this learner, she moves closer to the other learner who is also marking the group diagram)
1.15. Learner: Epidermis is wrong here Mam (shouted the first learner at the board)
1.16. Teacher: (Moving back to the first learner) Where? (The learner pointed what was wrong. The teacher re-drew the structure that was drawn incorrectly by the learners. The learner marked it correct.)
Teacher: (moving closer again to the second learner who is marking group A's diagram (stem)
1.17. Medulla…(looking closely this diagram is horrible. (She added what was missing in group B's diagram (root) and the she rub out group A's diagram. She re-drew the outside part of the stem diagram and asked the learners to try and complete it)
While learners from group A were trying to complete the stem diagram, learners from group B were filling in what was missing in their root diagram. This was prompted by the second question of the activity that required the to learners to list the difference between the stem and the root.
Group A seems to be struggling with their diagram.
Teacher: (stopping everyone so that they can all try solve group A's problem)
1.18. Wait, wait, wait 10Bs this is very easy, I said in the beginning you must count all the tissues that you have learned (The teacher is standing with the learner that was trying to draw the stem, she places her hand on the learners shoulders as they are both facing the class) Count the tissues (The

whole class and the teacher counted the tissues in a chorus, though the teacher is leading since the learners seem to be unsure of the correct tissues)
1.19. Teacher: Come again…start from the outside (The learners in a chorus count the tissues.)
1.20. Why is the epidermis on the outside?…hands up…(she claps her hands trying to draw the attention of a learner who is not listening.)
1.21. You are not paying attention…hey. (other learners seem to be giving the answers to the questions asked, the teacher is reprimanding those learners who are not paying attention)
1.22. This is very easy, you do not have to count the layers before you can draw, you just need to know the names of the tissues. The first one on the outside is?…(The learners answer in a chorus, the teacher is helping them emphasising the correct answers)
1.23. ….the xylem and the phloem inside…this is so simple, (class oh! ho!) (teacher continues) even here (pointing at the root diagram) the epidermis is always on the outside and it has the …(pointing at a structure)
1.24. Learners in a chorus: root hairs
1.25. Teacher: Why does it have root hairs?…(pointing to the name of the diagram) because this is a root (saying the answer together with the learners)
1.26…. and the next layer on the root diagram is? (class together with the teacher) parenchyma
1.27. Why parenchyma on the root? (class and the teacher) because it is a
1.28. Learners: it is a ground tissue and a storage tissue.
1.29. Teacher: Does it make sense?… hey (referring to a naughty learner at the back) you are not listening, you are focusing on the camera, if you want to appear on the video you must come forward. (class laugh)
1.30. Teacher: (Rubbing out the incomplete stem drawing) ok, let me draw this quickly so that we can go to number 2.
1.31. Number 2 find the differences between the root and the stem. I will give you one minute to look at it. (meanwhile the teacher drew the stem diagram) Learners are now quite as they look for differences between the stem and the root.
1.32. Teacher: Now look at the two diagrams one is that of a root and the other one the stem.
1.33. (Teacher drawing a table of differences between the root and the stem on the board) every time you look at differences, you tabulate. (looking at the class and dividing it into two groups, one group to focus on the root while the group is focusing on the stem)
Teacher: (pointing at the groups) root, stem. Right, you are going to write what you see is not there (referring to a learner from the stem group),
1.34 Teacher: and you must write the opposite, (referring to the learner from the root group)
The learner from the stem group wrote and the teacher is watching closely, the whole class is quite as the learners are trying identify the differences. As this learner finishes writing, the teacher calls out the next learner from the root group.
1.35 Teacher: the next one will come from this group (pointing at the root group) and the next from this group (pointing at the stem group)
1.36 Teacher: (pointing at a specific learner) come and write number one under the root and you Mzukulu come and write number two. (this a very naughty learner) (The teacher is now focusing on what the first learner from the root group is writing)
Mzukulu: 1.37 Which one must I write?
Teacher: 1.38 I do not know, you should know. (The class laugh) you are a root, check to see what is present in the stem but not on the root. What can you see?
1.39 Mzukulu: mumbling something (class laughs) (The teacher comes closer to Mzukulu and explain what is required of him) then he writes on the board and dance as he goes back to his seat (some girls laugh at him)
1.40 Teacher: (pointing at another learner from the stem side) your turn Ntwi (calling a learner by her nickname) (class laughs) to come and write number tow under the stem.
(group members are trying to help her.)

Teacher: 1.41 Why cheat? .. leave her she has got a mind of her own. (Ntwi wrote a wrong answer and the members of her group complained. One learner from the stem group quickly comes up, rub out the wrong answer and wrote the correct one.)
1.42 Teacher: (giving the chalk to the stem group member) this side number three, come and write number three and you (referring to the root side) must come and write the opposite.
1.43 Three … (a learner from the stem side is writing on the board while other learners are watching. A few girls from the root group started laughing at the learner that is writing on the board) As this learner finishes, one learner from the root side rushes forward and writes the opposite.
1.44 Next, number four from the root side.. (a learner from this group writes)
1.45 Teacher: The opposite of that … (a learner from the stem group comes and as she writes on the board)
1.46 Teacher: One more from this group (pointing at the stem group) as the learner finishes writing and the next one is about to write, the teacher stops her.
1.47 Teacher: Wait, (referring to the learner who is about to sit down). You must compare (pointing at what was written by the root group) compare the differences. (The learner realised her mistake and corrected it.)
1.48 Teacher: Now one more, (pointing at the centre part of the root diagram) this is very important, what do we call this? All this (blocking the central tissues with her hand) is called by one name, the….? (looking at class) (one learner shouts, the nucleus, another learner shouts stele, teacher ignores them and complains, no I do not want you to shout, as she goes to the board.)
1.49 Teacher: (writing on the board the term 'stele') the stele (saying this term together with the learners.)
1.50 and the stele consist of this, that and that? (Asking the learners and counting with her fingers, to indicate the number of answers expected) hands up. What does stele consist of? Hands up. (Teacher raising her hand, to show the learners what to do.)
1.51 Teacher: Sabelo (calling out name of a learner sitting at the back of the class)
1.52 Sabelo: the xylem
1.53 Teacher: yes, xylem.
1.54 Learner: (no names mentioned) phloem and the third learner: cambium
1.55 Teacher: Yes, phloem and cambium, good.
1.56 Teacher: (pointing at the structure) This is the stele, consisting of the xylem, phloem and cambium, inside the endodermis.
1.57 Teacher: (pointing at the stem diagram) Where is the stele this side? Where is the stele? (no response from the learners) (the teacher pointed at a particular structure within the stem diagram)
1.58 Teacher: Label: this structure (teacher becoming impatient) label, label.
1.59 Learners: (in a chorus) the xylem, (the listening and nodding as the learners name the tissue pointed) phloem and cambium.
1.60 Teacher: Right, now give me the differences between the two steles.
1.61 Teacher: (pointing at the root's stele) this one is like this, and this one (pointing at the stem stele) is like that, yes (pointing at a learner who wanted to answer)
1.62 Learner: The one from the stem (isakazekile) meaning that is scatted all over. (Teacher smiles) (The class laughs) (Teacher waited for the answer and the class became quiet).
1.63 Teacher: Say it in English (referring to another learner who was saying something).
1.64 Teacher: Give me a better answer. (As there was no response, the teacher wrote the differences on the table thus completing the answers for question 2 on the activity.
1.65 Teacher: Number three, activity number three. Write down the functions of these tissues in the diagram. I am giving you one minute. (teacher waited a bit and noticed that some learners were puzzled.)
1.66 No, you know them, you know them. Stop, let us revise, let us revise. (Again she divides the class into group A and Group B. The two groups are to alternate in giving the name of the tissue or its function. Any group that gives a wrong answer is marked down.)

1.67 Teacher: Hands up, hands up the name and the function.
1.68 Teacher: in the first round, group A – tissue and group B – function, in the second round, group B tissue and group A function. (Teacher drew a table on the board for the two groups. Under each group she drew ten lines representing the points.)
1.69 Teacher: On your marks, get set, ready, go. Group A, tissue? Yes Sabelo?
1.70 Sabelo: Root hair (the group complained … hoo …)
1.71 Teacher: No. (cross out a point from group A).
1.72 Learner: epidermis
1.73 Teacher: epidermis, yes, function? (referring to group B)
1.74 Learner: (from group B gave the answer. This exercise continued until all tissues and their functions were mentioned. The teacher totalled the scores and started all over again.)
1.75 Teacher: This time group B will give us the name of the tissue and group A its function. If you shout, I will give you a zero. (The game started all over again until all the tissues and functions were mentioned. The teacher re-enforced the correct answers by praising the learners. If the name of the tissue was mentioned twice, the group lost a point. Group B won this competition. While they were still excited, the teacher moved on to the next question. She rubbed out the board, still leaving the two diagrams on the board. She drew a table, now the learners were expected to write down all the tissues of the stem and the root and their functions.
1.76 Teacher: Close your books. (still keeping the two groups, one named the root and the other called the stem. She handed out pieces of paper to different groups of learners within the two main groups. Each sub-group was told what to do).
1.77 Teacher: This exercise will make sure that everybody participate because there are people who have not said anything.
1.78 Teacher: Stem and root (pointing at the two groups respectively)
1.79 Teacher: I am going to give you one piece of paper per disk, and you must write one of (handing out papers and mentioning the tissues) cellular hair, cuticle, epidermis, ...
1.80 Teacher: Close your books, close your books (some learners are saying to each other 'we do not have those functions', 'we do' others responding.)
1.81 Teacher: Ten, write down the tissues and their functions from each diagram, (learners are making some noise) ssh..ssh.., the ones that I gave you, ten, nine, eight, seven (learners are now working) six, five, four, three, two, one, finish. (She collected the pieces of paper from the learners.)
1.82 Teacher: One more (meaning one more piece of paper, learners are now noisy.)
1.83 Teacher: Ok, ok, quiet now (learners quieten down) we can't give marks for the wrong spelling (some learners are complaining about losing marks due to wrong spelling.)
1.84 Teacher: You willing mark their work (telling the stem group that they will mark the root group's work and visa versa.)
1.85 Teacher: Take one and pass it on. (Handing out the work to be marked)
1.86 Teacher: Let us all work together, I will write on the board. (Learners are noisy, she wrote a name of the tissue on the board and turned around.)
1.87 Quiet, quiet, just listen to me, listen! Right hands up, give me the function of the cuticle. Yes!
1.88 Learner: Transpiration.
1.89 Teacher: Transpiration. Is she correct? (Together with the class) No!
1.90 Teacher: What is the function of the CUTICLE? (teacher becoming impatient, turns towards the board and started writing the function)
1.91 Learner: prevent the loss of water (copying from the teacher's answer on the board.)
1.92 Teacher: Right, prevent the loss of water. Next one, epidermis (she writes it on the board and turn towards the learners) mark the first one wrong, what is the function of the epidermis?
1.93 Learner: protection
1.94 Teacher: protection, spelling correct?
1.95 Learner: Yes.

1.96 Teacher: Ok, Next one… (This exercise continued until all the tissues and their functions from both the stem and the root were mentioned. As it was difficult to get the correct answers from the learners, the teacher resorted to difficult to get the correct answers from the learners, the teacher resorted to granting points to the two main groups, if the answer came from the teacher, the responsible group lost a point. The learners started shouting the answers.)
1.97 Teacher: Stop shouting! Stop shouting! You are too many, there are sixty of you in this classroom. How am I suppose to hear what you are saying? (Learners quietened down a bit, the competition trick seem to be working. Learners are now giving answers, though some learners are just copying everything from the board as the teacher writes the answers.)
1.98 Teacher: Ok, (this was the end of the activity. The teacher wrote on the board, class activity and turned towards the learners who were now noisy, she waited a bit looking at them until they quieten down.) in this exercise I want you to use your class activity books to answer these questions.
1.99 Teacher: (reading and explaining the questions) Name all the tissues that you find in the root and the stem. Tabulate their functions. You do not need to draw the diagrams again. (Learners are copying down the questions.)
1.100 Teacher: Time is up. Copy this down. We will mark this tomorrow. Do not forget your test on Friday. It will start from the tissues up to now, the stem and the root. Use your notes book to do this activity and bring it on Thursday so that we can mark it. This exercise will help you in preparing for your test on Friday. Use both your notes and class activity books for your test.
1.101 Learner: …. (asking a question from the teacher)
1.102 Teacher: (responding to the learner's question) It is for secondary growth which we are going to study later. Yes Nqo? (This is another learner who is asking another question)
1.102 Teacher: Tomorrow!

Lesson 2

2.1 Teacher: Move! You are too slow. (referring to the learners as they enter her classroom. She moves to the board and opens some work on the board. Some learners are still finding their places to sit. It is very difficult to move in this classroom as it is overcrowded.)
2.2 Teacher: The work is over there. (turning the board so as to open the work to be done.)
2.3 Teacher: Pay attention grade tens, your work is over there. Let us mark our work, this will take us five minutes. Mark your own work. Use a lead pencil to mark, name the structures of the stem and the root. Once the structure is mentioned, mark it. Root first, hands up. Yes. (Pointing at the learner whose hand is up)
2.4 Learner: root hair.
2.5 Teacher: Yes, mark it. (This exercise continued until all structures of the root were mentioned. The teacher repeating the answer after every learner to ensure that everybody understands. She then placed the root structure with all the labels on the overhead projector.)
2.6 Teacher: is this the stem or a root? It is a root. (saying this together with the learners). Check if you have marked all the root structures. There are eleven of them. (She waited for a while and then switched the projector off.)
2.7 Teacher: Now name all the structures found on the stem.
2.8 Learner: Clarenchyma.
2.9 Teacher: Clarenchyma. Yes. Why do you start on the inside? You must always start on the outside because it makes it easier for you and save time. (She is now pointing at the stem structure that is still on the board.)
2.10 Learner: Cuticle.
2.11 Teacher: Yes, mark it. (This exercise continued for a minute or so, until all the stem structures were mentioned. One learner had a problem understanding the structure endodermis and epidermis.)

2.12 Teacher: Endodermis, Zibuyile (teacher drawing on the board) endodermis is like a skin or a layer inside. Epidermis is on the outside. (She underlined the word epi - outside and endo – inside, then dermis means the skin or the layer.)
2.13 Teacher: One more structure, medulla and cambium. (She place a stem structure on the overhead projector) Let us revise that.
2.14 Learner: What is the medulla?
2.15 Teacher: (Pointing at the stem structure on the transparency) Medulla is right here at the centre and this is the rail. (pointing at the structure around it) medulla is at the centre. Another name for it is the pith. Write that in brackets, pith.
2.16 Teacher: Now, I am not going to remove that. (pointing at the stem structure on the overhead project) I am not going to remove that. I want you to look at that (stem) and this (root structure on the board)
2.17 Teacher: Right, number two, what is the difference between the root and the stem? Compare them in a tabular form. (Learners were quiet and no one raised their hand.) it is only when I let you compete that you starts participating. Only when I say group A and B, otherwise others do not want to participate. (she placed both root and stem structures on the overhead projector) Compare these two.
2.18 Learner: Root hair.
2.19 Teacher: What about the root hair? The stem does have a root hair and root has a root hair for absorption.
2.20 Learner: The stem has a medulla and the root has no medulla.
2.21 Teacher: Yes, it is easy to compare, just look at the two diagrams. Look for structures that appear on one diagram but not on the other . those are differences.
2.22 Learner: Cuticle.
2.23 Teacher: Yes, the stem has a cuticle but there is no cuticle this side.
2.24 Learner: Cambium.
2.25 Teacher: Cambium, no, both have a cambium. Look here (pointing at the two structures on the overhead projector) Differences. One more, yes.
2.26 Learner: Stele
2.27 Teacher: They both have the stele, but here on the root the stele is at the centre and here on the stem, the stele is on the rail. That is the most important one, the real. Now, functions, (no response) functions. Start from the outside. Yes.
2.28 Learner: Root hair for water absorption.
2.29 Teacher: Yes, absorb water, mark that correct, next one.
2.30 Learner: Cuticle reduces loss of water.
2.31 Teacher: Yes. Epidermis?
2.32 Learner: Protection
2.33 Teacher: Yes, protection. (This activity continued with the teacher calling out the tissue names and learners mentioning their functions until all the tissues and functions were mentioned.)
2.34 Teacher: Right, you have a test tomorrow.
2.35 Learners: (Confidently in a chorus) Yes.
2.36 Teacher: Just sent your work down to me so that I can check it and give it back to you. Just send it down to me. Take out your notes books. Now there are two diagrams, one on the OHP and the other one is on the board. What are these diagrams? What is this? (pointing at the diagram on the OHP)
2.37 Learners: (In a chorus) the stem.
2.38 Teacher: (pointing on the board) and this?
2.39 Learners: the stem
2.40 Teacher: Yes, the stem. Both of them are stems. What is the difference between the two? (some learners are busy writing)
2.41 Teacher: Hey, grade 10s we are continuing with our work. What you were suppose to do yesterday can not be done now. Bring your work down now. If you did not finish, do not bring it.

Now pay attention. This is a stem and that is also a stem, ok? Say yes. (Pointing back at the OHP and the board) How do you know that these are both stems?
2.42 Learner: There is a cuticle in both of them.
2.43 Teacher: Yes, both has a cuticle. Now what is the difference between this one and this one. What is it that this is a root and this is a stem. (now placing both the stem and the root on the OHP)
2.44 Learner: The root has a root hair.
2.45 Teacher: Yes that is the most distinguishing structure, the root has a root hair and the stem has no root hair, secondly, the stem has a cuticle but the root has not cuticle. This is the most important difference.
2.46. Teacher: Right, (Pointing at the stem diagram on the OHP) this stem belongs to what type of a plant?
2.47. Learner: Dicot
2.48. Teacher: Yes, this one belongs to a Dicot and this one? Monocot (saying respectively and making the learners repeat their answers, she paused for a minute while the learners were looking at the two stems trying to find differences and saying oh! ok! As they noticed the difference between the two stems.)
2.49. Teacher: Right , Looking at them carefully because the next thing to do is to jot down the differences. Look at the labels, fortunately, there are few labels in the monocot and many labels in the Dicot. Just look at them, the green one is the…(learners said in a chorus-cuticle) cuticle on the outside and the pink one (the learners mentioned the structures as the teacher pointed at them.)
2.50. Teacher: What do we call this? (pointing at a particular structure in the monocot stem)
2.51. Learners: (in a chorus) Stele
2.52. Teacher: What do we call this? (pointing at a structure in the dicot stem)
2.53. Learners: (in a chorus) Stele
2.54. Teacher: What do we call this? (Pointing at a structure in the root diagram)
2.55. Learners: (in a chorus) Stele
2.56. Teacher: So, what is a stele? It consist of…
2.57. Learners: (in a chorus) it consist of the phloem, xylem and cherenchyma
2.58. Teacher: Ok, (she rubbed out the labels on the board and placed numbers instead) Right, the baboons and the monkeys (smiling and pointing at the usual two groups)
2.59. Learners: Ha! (complaining about the two new names for their group)
2.60. Teacher: Ok, group A and group B, structure and function. This time do not raise your hands I will just point at anyone. Label (pointing at group A) and function (pointing at group B) Just take one second to look at it. (meanwhile she wrote the two groups on the board and ten points each. These points will be marked down each time a group fails to give the correct answer.)
2.61. Teacher: (turning to the class) Ok, close your books now. Yes, number one.
2.62. Learner: (from group A) clerenchyma
2.63. Teacher: Yes good, function? (Learners from the other group gave the answer.) Do not shout. Yes, (this continued until all the numbers were labelled and functions given. Teacher re-enforcing all the answers.)
2.64. Teacher: (writing on the board then turning to the learners.) Right let me see if you can compare the differences between the dicot and monocot stems. Diagrams are too many, you do not have to cram them. All you need to do is to look at them, try and remember the labels and functions, and them compare. There are lots and lots of diagrams, about two pages. All you need to do is just label, functions and compare, that is all. Just look, tissues are the dame in some diagrams. So, we are just repeating one and the same thing. Anyone with a problem? You will not need to dram, you need to know the labels in order to compare. Do not cram the labels, you need to know where the structure is on the diagram so that you can understand its function. The cuticle is always on the outside because it protects the epidermis. Now write the differences.
2.65. Teacher: The dicot has a medulla and the cambium. Can you see the cambium there? (pointing at the monocot)
2.66. Learners: (in a chorus) No.

2.67. Teacher: Just do that in a simple, correct, English. It is important that you participate in class, talk so that I can see what is your problem. If you are just quiet I will not know. Some of you have not answered anything since we started.
2.68. Teacher: You, you and you (pointing at the active learners do not give me the answers. Give others a chance now. Let us do this activity together. Right, (pointing at one learner and then writing the answer on the board)
2.69. Teacher: Tell me the difference between the stele of the monocot and the dicot. Look at the arrangement this side and that side.
2.70. Teacher: This one is arranged in a circular manner and this one is scatted.
2.71. Teacher: (writing the differences on the board and learners copying them into their note books, turning to the learners) any problems now? No problems now? No problem.
2.72. Teacher: we are going to change this into another class activity. (the teacher rubbing out all the answers on the board and turning towards the learners.)
2.73. Teacher: Do this activity right now, you have fifteen minutes to finish it. You can do it in a piece of paper. (meanwhile the teacher is marking the learners' class workbooks.)
2.74. Learner: Do we need to draw these diagrams?
2.75. Teacher: (stopping what she was doing and start drawing a table on the board) No, you do not need to draw the diagrams, you do have them in your book. Just write the differences between the two stems in a tabular form. If you compare, you always tabulate. You have ten minutes. (Learners are busy with their work and the teacher is checking their class work exercise books and handing them back as she finishes checking.)
2.76. Teacher: Label numbers one to seven like this. (Pointing at the diagram on the board) Just do it on your own, you are writing a test tomorrow. (learners are now working quietly)
2.77. Teacher: Why do some learners do their work perfectly and on time, while others do not. Why? (she commented as she was checking their work and handing back their books) Thank you. I will not give you marks for the wrong spelling. I always insist on the correct spelling because you are going to become Doctors and Nurses. You are going to cut our ears instead of…or what ever. (She is now trying to move amongst the learners checking the work that learners are currently doing.)
2.78. Teacher: Spelling! (Pinching the ears of those learners who wrote wrong spelling) I want you to submit you work now and go fetch…so, let see how our test goes tomorrow. (She then wrote on the board the topics for the test, namely plant tissues, angiosperm anatomy; root; dicot stem and monocot stem.) Yes I am going to draw all the diagrams except one, bring your lead pencils. Study the labels, functions and compare. The one that you are going to draw, I will start it, then you will complete it. Ensure that you write the correct spelling. (She then made examples of words that are easily spelt wrong or confused)
2.79. Teacher: Finish, finish, finish. Time is up. The bell is not working, you must go now.

Lesson 3

3.1. Teacher: Hey you learners just keep quiet, please be quiet. I am in change in this class, just sit down and be quiet. Wait for the instructions. (she handed out the test scripts for the learners t mark.) This time you must not mark your own work. I am doing this exercise with you because I want us to mark this test and do remedial work in an hour. We are going to do everything in one hour. You must mark the work that is in front of you with a lead pencil or any other colour that is not the same as the one used for the work, except the red pen. Mark it neatly and accurately. You must participate and listen carefully. Take out your question papers. (she then started reading out the instructions on the question paper.)
3.2. Teacher: Answer for number one? A group of cells are called?
3.3. Learner: Tissue
3.4. Teacher: Mark that like this (making a tick on the board after writing the correct answer.) Two marks each. Mark that neatly.

3.5. Teacher: One point two, (learners are noisy) Please stop the camera for a while. (she then strongly reprimanded the learners for not concentration and for being noisy)
3.6. Teacher: Grade tens, what do you want me to do? Just tell….(after this the class quietened down and the teacher continued.)
3.7. Teacher: Grade tens do you know how you get two marks. One mark is for the correct answer and another mark is for the correct spelling. If the answer is correct but the spelling is wrong, you will get one mark only.
3.8. Teacher: 1.3 (writing this on the board) hair like structure in the stem of the ..... stem. The hairs that I told you about that they protect the plant from being ..... Yes, Nosipho.
3.9. Nosipho: root hairs
3.10.Teacher: No! Yes, Mlungisi?
3.11.Mlungisi: Triclone
3.12.Teacher: Triclone, good, (writing the word on the board to ensure that the learners see the correct spelling) That word you missed in class. I talked about it several times but you missed it in class because you were talking. I wrote it and I said …hhe..ya you still remember. (said this as some learners were responding positively.)
3.13.Teacher: What is the name of the shoot that goes down from the seed to the soil? The first shoot?
3.14.Learner: root hair.
3.15.Teacher: No! (making a drawing on the board) root hairs are here (adding them on her drawing.)
3.16.Learner: Primary root.
3.17.Teacher: No, it is a naditive (writing the word on the board) Last one, what is the structure that is at the tip of the root?
3.18.Learners: (In a chorus) root hair.
3.19.Teacher: No! You missed this one again. It was here on the board. It is a root cap, what is another name for the root cap? (As the learners were quiet, she wrote the answer next to root cap. I said, it protects the root. You were not listening. Right, the total for these questions is ten.
3.20.Teacher: 1.6 I need a letter there. The epidermis of a root has? A, B, C or D. (she drew the root on the board and the structure that she was asking for)
3.21.Learners: Root hairs
3.22.Teacher: Yes, what letter is that?
3.23.Learners: C
3.24.Teacher: Right, C (Writing that on the board. The teacher is writing all the answers on the board in a manner that the learners were supposed to write.)
3.25.Teacher: Learners, look at your question papers! (The teacher is becoming impatient now that the learners are not coming up with correct answers.) Ten B, did you study?
3.26.Learners: B
3.27.Teacher: 1.8 (For each question, the teacher had to explain, make drawings before the learners could give her the correct answers, sometimes she gave the answers herself and insisted on the correct spelling.) There are no other answers except those on the board. (There was a confusion, between the primary root and the tap root system. The teacher explained the confusion and told the learners that the only reason they missed this in class was because they were talking, she threw a piece of chalk at a learner who was talking right as she was explaining. This exercise continued until the whole question was marked) and your marks.
3.28.Teacher: Let us move to question two. Here you need to tabulate, as we will be looking at differences. It is a rule in Biology that you tabulate your answers whenever you compare two diagrams. Next time you will not get the marks if you do not tabulate. Yes, number one. Thokoza.
3.29.Thokoza: (gave a long answer which the teacher wrote on board)
3.30.Teacher: Mark it correct if it is there on the script that you are marking. When comparing the differences, why don't you start with an example? Why don't you start with examples?
3.31.Teacher: (seeing that it was very difficult to get answers from learners, she became mad and

started shouting at them) We have been doing this in class over and over again. Still, you can't give me the correct answers. Did you study at all?
3.32.Teacher: (pointing at a naughty learner) What is your example?
3.33.Learner: She did not write.
3.34.Teacher: I am not asking about the other person's answer, I want to know your answer. What did you write?
3.35.Learner: I did not write because ..... (making some excuses)
3.36.Teacher: Hey, you are not learning for me. You do not concentrate in class.
3.37.Teacher: In this question you had to compare. It is for eight mark, you need only four because it is two marks each. When you compare, you must talk about the same thing under each, e.g. if you give an example here, you must give an example here as well. (pointing at the two columns on the board) That is why you must do it in a tabular form.
3.38.Teacher: Question four. I like that one.
3.39.Learners: Question three.
3.40.Teacher: Ok, question three. Let us see how well you did on this one. Label the structures one to eleven on this diagram. Yes? (learners gave her the answers and she wrote them on the board and emphasised that they must check the correct spelling.)
3.41.Teacher: Now supply the functions of these structures. (Learners supplied the functions of all the structures)
3.42.Teacher: Learners, listen carefully, all along we have been saying that the roots and root hairs are for water absorption. I want to add something about the root cap. You must write this down on the script that you are making. The root cap increases the surface area for absorption. (some learners were making a lot of noise outside her classroom, she went out and reprimanded them) right, write that down, you are doing Biology Higher Grade. So, next time when you write the functions of root hairs you will say that they increase the surface area for absorption.
3.43.Teacher: Number seven? (There was a lot of noise coming from outside since it was now break time. Learners here were also becoming restless. The teacher had to stop and collected all the scripts.)

Lesson 4

4.1 Teacher: (Finishing rubbing out the board) Alright, put away your Physics
4.2 Teacher: Today I want us to look at the vascular bundle / the stele, the vascular bundle. This is the new word you heard yesterday. The vascular bundle / the stele. The stele consist of? Xylem, phloem, either clerenchyma or cambium. What the function of the two? Xylem is for the absorption of water and phloem is for the storage of food. (This is said by both the teacher and the learners) Therefore, I am going to give you a third name. What is your problem? (Referring to a learner who was not yet settled down. Apparently this learner did not have a chair.) I am going to give you a third term for the stele. It is the stele, the vascular bundle and the transporting tissues. It transport water and transport food. The fourth term will be conducting tissues because it conduct water and conduct food. What are the four terms Thandeka?
4.3 Thandeka: (Together with the teacher) the stele, the vascular bundle, the transporting tissues and the conducting tissues.
4.4 Teacher: Right, let me write that on the board. Today I am going to take you to the laboratory.
4.5 In the Lab we are going to take the vascular bundles and put them in a solution and look at the tissues.
4.6 We are going to work in two's, choose a partner, find a piece of paper and look at the microscope to see what the tissue look like.
4.7 You are now in the lab – take your partner. Just take one piece of paper and share, just one piece of paper that you can share, so that you can draw tissue from the microscope, so that you know how it looks like under microscope. (The teacher switched on the overhead projector and told the learners that the OHP is their microscope. The learners mourned, as they were thinking that

they were going to use a real microscope. The teacher did this because the real Biology lab has been broken into and vandalised. So she is now improvising.)
4.8 Teacher: For your information, this type of a lesson is done in the lab, but we are doing it here because our lab has nothing left after numerous break ins.
4.9 So this is our lab. Work with your partner, you just need a lead pencil and one piece of paper.
4.10You just need a … I am talking to everybody, Mzukulu, I am talking to you. (Referring to a naughty boy who is busy talking to his friend.)
4.11. I still need my class back, I really need it. (referring to the laboratory, seeing that it will not be easy to do this lesson without proper apparatus.)
4.12. Zibuyile, you are still in my class and I still need to teach. (The teacher said this as she was placing the diagram of a stele on the OHP and this learner was disrupting her by making noise.)
4.13. I am not going to repeat what I said yesterday about how to behave in class.
4.14. Right, you have seen this before. (Referring to the diagram that is now on the OHP.)
4.15. I once showed you this when we were talking about the xylem. I told you that the tube like structure (pointing at the diagram) this is a drop of water and this is one type of a xylem, and that is another type of a xylem. (pointing at another structure) never mind the colour I just used a different colour so that you can see what I want you to see.
4.16. The xylem is not like this, the colours just indicate different tissues that I want you to see.
4.17. I have shown you two types of a xylem, the one is just a tube and the other one is a stirrup like that for strength and support. (Pointing at it in the diagram, the other parts of a diagram covered)
4.18. Underneath, there is another type of a xylem, and who can guess what this is, it is not a xylem (pointing at another structure in the diagram)
4.19. Learner 1: phloem.
4.20. Teacher: Why do you say it is a phloem?
4.21. Learner 2: Because of water.
4.22. Teacher: No, not because of water.
4.23. Learner 3: I think, it is because it can store food.
4.24. Teacher: Ahh, think of the time when we were doing the tissues, the phloem, (Pointing at the diagram) this is a xylem because you can see the leading tube, the strength is there, this is another type of a xylem. There are four types of a xylem, one is tube like, rings, the other is stirrup, another one is spiral, so you can tell that this is a xylem, and this one, it is a phloem I agree, but why? Anyone? (Waited for a while for the correct answer. Some learners are mumbling something)
4.25. Teacher: Think of it in terms of a structure. (Raising her voice) yes? (pointing a learner)
4.26. Learner 1: Tube.
4.27. Teacher: Tube, almost right. Yes (pointing at another learner)
4.28. Teacher: it has got two tissues, the what and what? Hhee, the tube and ….. (Some learners are mumbling something)
4.29. Teacher: it has still tube and, and, (waiting for the answer) and a companion cell, Grade ten Ayi.. ayi.. We are not moving forward. (Shaking her head as a sign of dissatisfaction at their participation and memory.) What does it have?
4.30. Learners: (In a chorus together with the teacher) Still tube and a companion cell.
4.31. Teacher: (Drawing on the board, making large clear diagrams) Is it not like this, hhe, is it not like this?
4.32. Learners: (In a chorus) Oh, yes, yes.
4.33. Teacher: What does it have? (together with learners) a still tube and a companion cell.
4.34. Teacher: (pointing at the diagram on the OHP) still tube and companion cell, which one is which?
4.35. Teacher: (Together with learner) still tube, companion cells, still tube, companion cells (teacher pointing at the two structures alternating.)
4.36 Teacher: Ja, let us start here with your partner (pointing at the diagram she drew on the

board) this is how we drew from the book, this is just a plain diagram of the phloem, it is not really like this. When you are in the lab looking under a microscope, this is how you see it. (Pointing at the transparency diagram over the OHP.)
4.37 Teacher: So, with your partner, I want you to draw it exactly like this. (Pointing at the OHP) This is how it is when you look at it from the microscope. Let us start with a phloem, with your partner, try! And label. (Learners are now noisy as the partners argue who is going to draw) Just between the two of you, you must help each other. (The teacher is now writing something on the board while the learners are working)
4.38. Teacher: Come let us make a plan here, (pointing at the diagram on the board as task one. Learners are now working, but they are still making noise.)
4.39. Teacher: I am giving you two minutes to do that (raising her voice above the noise level.)
4.40. Teacher: Now, draw that, label the names of the tissues. There are other tissues, there are thick up there in the corners. What do you think those tissues are? The other tissues there, what do you think they are. Label them as well. (Now learners are really busy at work)
4.41. Teacher: Right, this is a phloem tissue, you have labelled it, so that is... Hawu! (Seeing something wrong in one pair, then she helped them out.)
4.42. Teacher: Right, since there is only one of you in a pair making the diagram, the other one must give the functions of it.
4.43. Teacher: I do not want a portrait diagram or other beautiful diagrams, I just want this diagram as is, an ugly diagram like this one, because this is how the phloem is. (Teacher is pointing at a diagram over an OHP, after seeing what other learners are drawing. She is insisting that they must draw the phloem as is under the microscope.)
4.44. Draw the phloem, label it, also label the tissue cells around it, and give the functions. (The teacher is moving around checking what the learners are doing).
4.45. Right, five, four, three, two, one your time is up, I remove this. (She removed the transparency from the OHP, some learners said 'oh' meaning that they were still busy)
4.46. Now, listen learners. Learners, learners hey! Learners, when we are in the lab, we do not use books. There are no books on our tables, just look at this, you do not need books or exercise books (placing the diagram back on the OHP.) Just observe and draw what you see as is on the specimen like this. Do not draw from the book, draw from the specimen. Close your books.
4.47. Look here, this is a still tube and the companion cell, and the tissues around it, the supporting tissues, what are they? What? (Pointing at a learner)
4.48. Learner: Plant cells
4.49. Teacher: Plant cells, no. I think Zibuyile did say that these are clerencyma or cholenchyma, these, are the supporting tissues. Just draw as it is.
4.50. I remove this now, (removing the transparency for the second time) now let us go on to task number two. Pay attention!
4.51. Pay attention! Because I am going to put this (placing another transparency on the OHP) up for a short time. Pay attention.
4.52. We are now going to the vascular bundle (the stele) the vascular bundle. (She is writing vascular bundle on the board as she speaks.) it consist of xylem, phloem, cambium or clerenchyma sheath.
4.53. There is cambium, if it is a dicot or clerenchyma sheath if it is a monocot.
4.54. I will put this up for a short time, just to remind you. (She is placing a diagram on the overhead projector.)
4.55. This, looks like a stem. It is a stem, and this is another stem, here is a cuticle, the epidermis, the parenchyma, the ... stele, the pith (Mentioning all the labels of the stem together with learners and pointing at the different structures)
4.56. The stele, it looks like this when you look at it under the microscope. Let us revise again. (Saying this together with the learners. They mentioned all the structures of the stem) Yes, there4, is the stele, or the pith, or the medulla rail.

4.57. Can you remember this now? Ok, I am going to remove this because I want to show you only this part. (Pointing at a particular structure of the stem.) the stele.
4.58. I am going to show you only the stele. Oh, before I go there, (placing the diagram again on the OHP) This is a dicot stem because the stele is arranged in a circular shape or a ring. This is a monocot stem, and the stele is scatted, see the cuticle and the parenchyma, that is all that you can see because it is scatted. This is the monocot stem and this is a dicot stem. It is not a root because there are no root hairs. So now I am going to show you this and that.
4.59. Teacher: Now I am going to show this and that (pointing at the monocot stele and the dicot stele)
4.60. There, you are (showing them the new diagram) This, is the xylem tissues and that is a vascular bundle.
4.61. I am showing you this, the whole of that (pointing at the diagram)(with your partner, again you must draw this and label the vascular bundle as you see it on the specimen.
4.62. that, is a xylem, and this is a vascular bundle. I am going to give you a clue, this one is next to this one because it is a monocot. This one is next to this one because it's a dicot. (She is pointing at the structure from each vascular bundle.)
4.63. So, this is a monocot vascular bundle. Draw and label it, choosing from these. (pointing at the four terms she wrote on the board when she was talking about the components of the stele.)
4.64. Draw as you see it from the microscope. This is your microscope (pointing at the overhead projector.)
4.65. This, is the actual xylem, actual phloem and the actual clerenchyma sheath as seen under the microscope. (She wrote task three on the board as the learners were busy with their work. Learners are still talking, maybe explaining to each other what to do. The teacher is moving around checking their work, clarifying the instructions where needed.)
4.66. Teacher: Grade tens, stop. Stop, stop, stop! This for the hundred times, when I ask you to pay attention. (As she notices that the learners are copying from the books and writing the wrong things.) Your work is on the board and the screen. Draw what you see on the board. Draw what you see! Put away the books.
4.67. When I showed you the companion cell there was no nucleus. Was there a nucleus? No. (saying this together with some learners. She continued checking and marking the work of the entire class.)
4.68. There, is no cell wall here, please correct it. (Referring to a group of learners who wrote cell wall as on of the labels.)
4.69. You are almost there. (referring to the learners as she was about to finish checking and marking their work. That was the end of the lesson.)

Lesson 5

5.1. Teacher: Yesterday I asked you to draw the tissues as you see them under the microscope. That is, how they look like in reality, remember.
5.2. Learners: Yes
5.3. Teacher: All along we have been looking at the tissues of the root and the stem, ok.
5.4. Now, today we are going to do the leaf, but I am not going to tell you how it look like. I am not going to tell you anything.
5.5. I just want you to use the knowledge that you have, of the tissues and their structures, shapes, characteristics and their functions.
5.6. I want to see if you can apply your knowledge if I give you a diagram of a leaf.
5.7. I am going to hand out these papers. Work in your pairs again, because you have got to draw.
5.8. I have drawn the structure. (she say this as she hands out papers with the skeletal structure of the leaf.)
5.9. Each and every pair is going to receive a paper with the plain structure of a leaf. Just pass it on to each desk.

5.10. This, is a leaf (drawing an outline on the board that is similar to what is drawn on the papers given to learners. Turning to the learners who are now noisy) Grade ten, how many times must I tell you that I can not give you the instructions if you keep on talking.
5.11. I have given you something like this. Just work in twos, I am going to give you a blank page so that if you make a mistake, or if you want to draw your own, you can use it. (she handed out blank sheets of papers, one per pair.)
5.12. Now, you know all these words (pointing at the words she listed on the board as part of the activity)
5.13. Learners: (in a chorus) Yes
5.14.Teacher: (read our all the words that were on the board. The learners were saying yes after each word until one word, palisade, which the learners thought they did not know. The teacher explained that they know that word. She said that palisade is the one that contains chloroplast. It is not new, it is nor new.
5.15. Learners: Oh! (remembering that indeed they knew the word.)
5.16. Teacher: I said you must close your books, but I wish you should open them so that you can see that palisade parenchyma was the one with chlorenchyma, but palisade is the one with chloroplast.
5.17. I am going to add this one (writing on the board) leaf vein. You are going to need this one, leaf vein.
5.18. Now, this is the structure of the leaf cut longitudinally (pointing at the drawing on the board.)
5.19. It is the same as the one that I gave you. This is the leaf vein (adding some structures on the leaf outline.)
5.20. Here, are the words on the board. I want you to try and draw these structures (pointing at the diagram on the board and adding the new structure.) Thicken your cell walls, there you are, and where you know they are situated.
5.21. Where in a plant tissues, would you find the cuticle? Where would you find the upper and the lower epidermis? (she mentioned a number of structures)
5.22. I am going to give you one clue (she label the leaf vein on the leaf structure)
5.23. I am going to give you five minutes to do this, Just draw the structures as they are, and where you know they are situated.
5.24. Let me add something, this thickened cell wall here (pointing at the diagram on the board and adding the new structure.) Thicken your cell walls, there you are, perfect.
5.25. I am going to give you another clue, (adding something on the diagram)
5.26. You have three minutes to go. I am going to give you a mark for a neat well labelled diagram. (learners are now busy with their work and the teacher keeps on counting down) Two minutes left.
5.27. one minute left, come on, come on, come on. (she is moving around checking the learners' work) Perfect! This one is good, and this one is good (As she sees some good diagrams) You, (pointing at the pair of naughty boys) must change your attitude. When I give you instruction it takes time for you to understand because you keep on imitating what I am saying.
5.28. Listening is a skill in learning. You do not listen. (other learners are busy at work, so the teacher decided to extend the time.)
5.29. Hhey! Hhey! I said the xylem consist of…(the teacher is correcting the mistakes as she moves around)
5.30. Teacher: (raising her voice) Is there anyone who needs help? Anybody? (No response as the learners are busy at work though the class sound is noisy)
5.31. Right, time is up. I forgot to tell you something, that is a dicot leaf.
5.32.Learner: (shouting from a background) I could tell that this is a dicot leaf because of the cambium. The cambium gave it away.
5.33.Teacher: Good. One last thing, give me the function of this, this and that (pointing at the structures)

5.34. You are almost there (checking the time) just give the functions of the cuticle, what does the cambium do between the xylem and the phloem? You know the answers. You know them.
5.35. Teacher: (talking to one group) you are missing the stoma.
5.36. On which part of the leaf are you going to draw the stoma, Zibuyile?
5.37. Learner: Here, see.
5.38. Teacher: No, I cannot see. On which part of the dermis? Yes (pointing at another learner.)
5.39. Learner: On the lower epidermis
5.40. Teacher: Good, on the lower epidermis
5.41. Listen why don's we find the stomata on the upper epidermis (she goes to the board and point at the upper epidermis. What do we find here?
5.42. Learners: (in a chorus) cuticle.
5.43. Teacher: What is the function of the stomata?
5.44. Learners: (in a chorus) For gaseous exchange
5.45. Teacher: Yes, and....(wanting more answers and the learners giving her the answers.)
5.46. Why does a stomata open and close?
5.47. Learners: (shouting different answers) for respiration, respiration....
5.48. Teacher: Wait! Wait! Let us give a correct answer, what are the functions of the stomata?
5.49. Learners: (in a chorus) gaseous exchange, transpiration.
5.50. Teacher: Define transpiration.
5.51. Learner: When water goes up and....
5.52. Teacher: No, it is when the leaf loses water. What is the function of the cuticle?
5.53. Learners: It controls water loss
5.54. Teacher: Yes the stoma does open and closes for gaseous exchange. What was going to happen if the stomata were on the upper epidermis and the cuticle on the lower epidermis?
5.55. Learner: The leaf would lose a lot of water.
5.56. Teacher: Yes, because the sun would heat it directly causing a lot of water loss. This is another reason why the stomata are underneath and not on the upper surface.
5.57. Teacher: Ok, time is up. Just write your names on those pieces of papers and submit them to me. (this is the end of the lesson.)