AN EXPLORATION OF THE INTERFACE BETWEEN SCHOOLS AND INDUSTRY IN RESPECT OF THE DEVELOPMENT OF SKILLS, KNOWLEDGE, ATTITUDES AND VALUES (SKAV) IN THE CONTEXT OF BIOTECHNOLOGY

By

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DECLARATION

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ABSTRACT

This study traces how the National Curriculum Statement-Further Education and Training (NCS-FET) Life Sciences Policy is constructed and translated as it circulates across the Department of Education (DoE), schools and industry nodes. Actor Network Theory (ANT) (Latour, 2005) guides the theoretical framework and methodology of this study. ANT is a useful tool for showing the negotiations that characterise patterns of curriculum change in terms of how policy gets constructed, how practice gets performed, the skills, knowledge, attitudes and values (SKAV) constituted in practice, and whether there is an interface in terms of policy construction and SKAV constitution. From an ANT perspective curriculum policy change is a matter of practice co-performed by sociality and materiality, these being interwoven and entangled in practice. The trajectory of the NCS-FET Life Sciences Policy is traced during the practice of mediation of policy, implementation of policy and mediation of workplace learning.

The topography of this study is underpinned by the transformatory agenda attached to curricula policy reform in South Africa. Agency has been granted by the democratically elected government to structures such as the DoE, schools and industry to promote human resource development and overcome the skills shortage via the NCS-FET Life Sciences Policy (DoE, 2003) and the National Biotechnology Strategy Policy (DST, 2001). There are divergences between these two documents as to the type of biotechnology that can be used as leverage for human resources development. The controversy lies in the notion of wanting to broaden access to biotechnology by having it included in the NCS-FET Life Sciences Policy, while wanting to promote third-generation biotechnology. Furthermore, contradictions are illuminated in the constitution of the NCS-FET Life Sciences Policy: it espouses constructivist principles and has a social transformative agenda, but its construction is guided by behaviourist and cognitivist principles.

Employing the analytical tools offered by ANT (Latour, 1993, 2005; Callon, Law & Rip, 1986), the network tracing activity reveals that policy construction and SKAV development involve more than the action of a single human actor. This means that humans are not entirely in control of practice (Sorenson, 2007). Practice is performed by a series of shifting relations between elements of "sociality" and "materiality" (Mulchay, 2007). The network tracing activity elucidates that curriculum policy is an emergent effect of the interface, a dynamic point that arises from translations in the network. While there is an interface in respect of policy construction and SKAV constitution across the nodes of the study, the emergent effect of curriculum reform has pointed to the slippage between what was intended (via the policy as stated in the *Government Gazette*) and what was actually experienced in practice.

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DEDICATION

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ABBREVIATIONS

ANC	African National Congress
ANT	Actor Network Theory
AS	Assessment Standard
C2005	Curriculum 2005
CASS	Continuous assessment
DACST	Department of Arts, Culture, Science and Technology
DET	Department of Education and Training (previous apartheid department for Africans in urban areas)
DO	Developmental outcome
DoE	Department of Education
DoL	Department of Labour
DST	Department of Science and Technology
EO	Education Officer
FET	Further Education and Training
GET	General Education and Training
HoA	House of Assembly (previous apartheid department for whites)
HoD	House of Delegates ((previous apartheid department for Indians)
HSRC	Human Sciences Research Council
IKS	Indigenous Knowledge Systems
IQMS	Integrated Quality Management System
JIPSA	Joint Initiative on Priority Skills Acquisition
LO	Learning outcome
NBSD	National Biotechnology Strategy Document

NCS-FET	National Curriculum Statement-Further Education and Training
NSC-FET	National Senior Certificate-Further Education and Training
NTEW	Non-tertiary educated worker/s
NQF	National Qualification Framework
OBE	Outcomes-based Education
PPN	Post-provisioning norm
TQP	Tertiary qualified personnel
SCANS	Secretary's Commission on Achieving Necessary Skills
SEM	Superintendent Education Management
SGB	School Governing Body
SKAV	Skills, knowledge, attitudes and values

TABLE OF CONTENTS

Title page	i
Declaration of originality	ii
Abstract	iii
Acknowledgements	v
Dedication	vii
Abbreviations	viii
Table of contents	x
List of tables	xiii
List of figures	xiv
Note to the reader	xv
Chapter One: Cartesian grid: Mapping the topography	1
1.1. Introduction	1
1.2. Mapping the NCS-FET Life Sciences policy's link to biotechnology	2
1.3. Mapping the conceptualisation of biotechnology within the NBSD	3
1.4. Mapping the conceptualisation of biotechnology within the NCS-FET Life Sciences policy	4
1.5. Mapping the preliminary study	4
1.6. Mapping the use of Actor Network Theory	10
1.7. Mapping the stage for the dissertation	12
1.8. Mapping ANT's terminology	15
1.9. Conclusion	17
Chapter Two: Mapping the theoretical terrain and Literature review	19
Part A: M aping the theoretical terrain	19
2.1.1 Introduction	19
2.1.2. Mapping the search for a theoretical framework	20
2.1.3. Mapping the distinctive tenets of ANT	21
2.1.3.1. Sociology of the social vs sociology of association	21
2.1.3.2. Mobile framework	23
2.1.3.3. Unique vocabulary and theoretical implications for tracing and assemblage	24
2.1.4. Resolving uncertainties	29
2.1.5. Spokesperson for the nodes	32
2.1.6. Conclusion	32
Part B: Mapping the literature review	33
2.2. 1. Introduction	33
2.2.2. Review of scripts	33
2.2.2.1. The policy canopy in South Africa	34
2.2.2.1.1. Platform for reform	34

2.2.2.1.2. Initiation of reform 36
2.2.2.1.3. Structures of reform 36
2.2.2.1.4. Vacillations in curriculum policy reform 37
2.2.2.1.5. Resultant dilemmas of curriculum policy reform 38
2.2.2.1.6. OBE underpins FET curriculum policy reform in South Africa 39
2.2.2.2. Uncertainties of the role of schools in society 40
2.2.2.2.1. Capitalist theorists 40
2.2.2.2.2. Reproduction theorists 41
2.2.2.2.3. Transformation theorists 42
2.2.2.3. Mismatch in the preparedness of learners for the world of work 43
2.2.2.4. Networks between the school science curriculum and industry 44
2.2.2.5. Overview of the NCS-FET Life Sciences policy 49
2.2.2.6. Constitution of the NCS-FET Life Sciences policy 50
2.2.2.7. Conclusion 60

Chapter Three: Mapping the Methodology 62

3.1. Introduction 62
3.2. Mapping the writing of an ANT report 63
3.3. The practice trailed at each node 67
3.3.1. DoE node 67
3.3.2. School node 68
3.3.3. Industry node 69
3.4. Mapping the “objectfullness” of the data constituted 70
3.5. Mapping the research design of the study 71
3.5.1. Mapping the gaining of access 71
3.5.2. Mapping how data is constituted 76
3.5.2.1. DoE node 77
3.5.2.2. School node 78
3.5.2.3. Industry node 81
3.6. Mapping the design for analysis 83
3.7. Conclusion 85

Chapter Four: Mapping the social 87

4.1. Introduction 87
4.2. Mapping the presentation of findings and discussion 88
4.2.1. DoE node 89
4.2.1.1. Practice gets performed as negotiable moments of obedience seeking 90
4.2.1.2. Construction of policy 93
4.2.1.2.1. Construction of policy as superior 94
4.21.1.2.2. Construction of policy as premature and powerful 96
4.2.1.2.3. Construction of policy as endangered 98
4.2.1.2.3. Construction of policy as a hindrance 99
4.2.1.3. Optical density of the DoE node 100

4.2.1.4. SKAV constituted in practice 101
4.2.2. School node 103
4.2.2.1. Practice gets performed as a juggling act 104
4.2.2.2., Construction of policy 105
4.2.2.2.1. Construction of policy as experimental, mutating and estranged 105
4.2.2.2.2. Construction of policy as an alien invader 108
4.2.2.2.3. Construction of policy as a game 109
4.2.2.2.4. Construction of policy as a hindrance 111
4.2.2.3. Optical density of school node 113
4.2.2.4. SKAV constituted in practice 114
4.2.3. Industry node 116
4.2.3.1. Practice gets performed as a construction process 117
4.2.3.2. Construction of policy 118
4.2.3.2.1. Construction of policy as a building block 118
4.2.3.2.2. Construction of policy as a hindrance 118
4.2.3.3. Optical density of industry node 119
4.2.3.4. SKAVs constituted in practice 120
4.3. Conclusion 121

Chapter Five: Emergent effect of curriculum policy reform 124

5.1. Introduction 124
5.2. Is there an interface? 126
5.2.1 Nodal overview of policy construction 126
5.2.1.1 DoE-schools interface 127
5.2.1.2 DoE-industry interface 128
5.2.1.3 School-industry interface 128
5.2.1.4. DoE-School-industry Interface 128
5.2.2. Nodal overview of SKAV constitution 129
5.2.2.1 Doe-School interface 130
5.2.2.2 DoE-Industry interface 131
5.2.2.3 School-Industry interface 131
5.2.2.4 DoE-Schools-Industry interface 132
5.3. The nature of the interface 132
5.4. Unveiling curriculum policy reform 135
5.4.1. Curriculum policy reform as *bricolage* 136
5.4.2. Espoused policy slippage *vis- a -vis* enacted policy 137
5.4.3. Heroic performance of a human actor vis- a vis multiple actors 142
5.4.4. Gaps within the curriculum policy reform process 143
5.4.5 Reflections on the use of ANT 145
5.5. Conclusion 146

Bibliography 148
List of Appendices and page numbers 163

LIST OF TABLES

Table 1: Total number of employees and the qualification of the employees engaged in the application of biotechnology

Table2: Relationship between Life Sciences LOs and the critical and developmental outcomes

Table 3: Cognitive levels of Bloom's taxonomy and the NCS-FET Life Sciences Policy

Table 4: Padilla's science process skills and LO1 competencies of the NCS-FET Life Sciences Policy

Table 5: LO3 competencies of the NCS-FET Life Sciences Policy

Table 6: Nodal view of policy construction and SKAV constitution

LIST OF FIGURES

Figure I: Points of interface in this study

Figure II: Actors enrolled during mediation of policy

Figure III: Actors enrolled into implementation of policy

Figure IV: Actors enrolled into mediation of workplace learning

Figure V: Points of interface

Figure VI: Interface in terms of policy construction and SKAV constitution

Figure VII: Nature of interface

Figure VIII: Negotiations occurring at each node

NOTE TO THE READER

Dear readers, please note that this dissertation has been organised into five chapters, as depicted below:

Chapter One	Mapping the topography for the study
Chapter Two	Part A: Mapping the theoretical terrain Part B: Mapping the literature review
Chapter Three	Mapping the methodology for the study
Chapter Four	Mapping the presentation of findings and discussion
Chapter Five	Mapping the emergent effects of curriculum policy reform

In Chapter One of the dissertation I assume the role of a cartographer and map out the topography for the study. The topography is underscored by: Firstly, the divergence in the type of biotechnology foregrounded by the National Curriculum Statement-Further Education and Training (NCS-FET) Life Sciences Policy (Department of Education (DoE), 2003) *vis-à-vis* the National Biotechnology Strategy Document (NBSD) (Department of Science and Technology (DST), 2006). Secondly, the research report on the dissatisfaction of industry with the lack of skills in their workers (Secretary's Commission on Achieving Necessary Skills, 1991; Joint Initiative on Priority Skills Acquisition, 2007). Thirdly, the requisites of the NCS-FET curriculum to "meet the human capital needs of our country" (Dugmore, 2007, p. 7). Interrogating these issues led me to conduct a preliminary study which found:

- divergence in the type of biotechnology foregrounded by industry and the NBSD (DST, 2001),
- divergence in the type of skills, knowledge, attitude and values (SKAV) required by these industries,
- who engages in the application of biotechnology,

- the type and nature of partnerships that exist between the DoE, schools and industries, and
- divergences in the NCS-FET Life Sciences Policy negotiation process.

This lead me to carry out the main study, which explores firstly how policy gets constructed and translated in practice, and which SKAV are constituted in practice at the DoE, schools and industry node, and secondly if there is an interface among the nodes in terms of policy construction and SKAV development, and if so what the nature of the interface is.

Chapter Two maps out the theoretical terrain, namely Actor Network Theory (ANT) (Latour, 1989; 2005 Callon, Law & Rip, 1986), a distinctive approach to research concerned with the tracing of networks. The concepts offered by ANT are used to identify the uncertainties and controversies among the nodes of our study, namely DoE, schools and industry. Relating ANT's conceptual tools to the literature allows me to reveal the many surprising sets of agencies, uncertainties and controversies that have to be disentangled at our different nodes in order to trace SKAV development and finally converge on the interface.

Chapter Three maps the research design for this study; it also demonstrates how to use ANT as a methodology, which brings the methodological implications and challenges to the fore. The research design also explicates how issues of object fullness (i.e. validity and reliability) were adhered to in this study.

Chapter Four entails presentation of findings and discussion. The divergent and convergent ways in the construction of policy are illuminated at a cross-nodal level. The performance of practice by elements of sociality and materiality dispels the myth of the heroic performance of human actors during curriculum policy reform. The SKAV constituted at each node are made apparent.

Chapter Five focuses on the interface or the actor network of the study. It reflects on the theoretical challenge of tracing shifting targets, stabilising networks, mapping interfaces and highlighting the emergent effects of curriculum policy reform.

CHAPTER ONE

CARTESIAN GRID: MAPPING THE TOPOGRAPHY

"Associations account for the social, the social cannot account for associations"

Latour (2005, p. 240).

1.1 Introduction

This study follows the National Curriculum Statement-Further Education and Training (NCS-FET) Life Sciences Policy within the context of biotechnology, as it travels across the three nodes[1] of the study, the Department of Education (DoE), schools and industry. This is in order to map the interface of these three nodes in the construction of policy as well as the constitution of competencies. I assume the role of a cartographer and map out the topography of the study. It needs to be highlighted that curriculum policy reform in the new South Africa is underpinned by a transformatory agenda which promotes the use of education via biotechnology as leverage for human resources development. In light of the above, I bring to the fore the following concerns:

- Divergence in the type of biotechnology foregrounded by the National Biotechnology Strategy Document (NBSD) for South Africa (Department of Science and Technology (DST), 2001) and the NCS-FET Life Sciences Policy (DoE, 2003) on the use of biotechnology as leverage for human resource development,
- Industry's dissatisfaction regarding new workers' lack of skills (Secretary's Commission on Achieving Necessary Skills (SCANS), 1991; Joint Initiative on Priority Skills Acquisition (JIPSA), 2007),
- the requirements placed on the NCS-FET Policy for a curriculum to "meet the human capital needs of our country" (Dugmore, 2006, p. 7),

[1] Node: Connection point or distribution boundary in a network (Heads, 2004).

- uncertainty on the role of schools in a new South Africa, and lastly
- my personal engagement with the Life Sciences curricula (previously known as Biology) over the past two decades as a secondary school teacher.

These concerns led me to conduct a preliminary study, which will be discussed further in section 1.4. Arising out of the findings of the preliminary study, this research project questions the ability of the current NCS-FET Life Sciences Policy to provide learners with an appropriate background for the world of work in the context of biotechnology. The purpose of this study is twofold: firstly, it aims to interrogate how the NCS-FET Life Sciences Policy is constructed and translated in practice as it circulates across the DoE, schools and industry nodes; and secondly, it explores whether there is an interface in terms of policy construction and skills, knowledge, attitudes and values (SKAV) constituted across the nodes. If so, what is the nature of the interface?

The controversies around the conceptualisation of biotechnology and uncertainties about the role of schools were explored against the backdrop of Actor Network Theory (ANT) (Latour, 1993, 2005; Callon, Law & Rip, 1986).

1.2 Mapping NCS-FET Life Sciences Policy's link to Biotechnology

The DoE was requested by the DST to support its drive to use biotechnology as leverage for education, and was asked to include biotechnology in the secondary school Life Sciences curriculum. The DST also appealed to the DoE to include biotechnology in all teaching institutions (DST, National Biotechnology Strategy for South Africa, 2001). The DoE acceded to the request of the DST and included aspects of biotechnology in the NCS-FET Life Sciences curriculum. This inclusion of biotechnology in the NCS-FET Life Sciences Policy awoke in me the need to scrutinise the conceptualisation of biotechnology in both the NBSD (DST, 2001) and the NCS-FET Life Sciences Policy. How these two documents conceptualise biotechnology is outlined below.

1.3 Mapping the conceptualisation of Biotechnology within the NBSD

The NBSD (DST, 2001) reveals that biotechnology has three categories:

Category 1: First generation - use of selected biological organisms to produce food and drink (e.g. beer, dairy products, yeast);

Category 2: Second generation - use of cells or tissue cultures to yield new products (e.g. antibiotics, enzymes, vitamins); and

Category 3: Third generation - commonly known as modern biotechnology, is associated with recombinant DNA technology.

It is third-generation biotechnology that the NBSD foregrounds as a means of addressing backlogs in human resource development (DST, 2001). Herein lies a divergence - between the promotion of biotechnology as leverage for human resources development (DST, 2001) and third-generation biotechnology. To be able to engage meaningfully with third-generation biotechnology, individuals would have to have a knowledge base that extends beyond the school curriculum to tertiary level. In this regard it is worth noting that out of the 17% of matriculants in South Africa who can access higher education institutions, fewer than 4% pursue courses in the science disciplines (Human Sciences Research Council (HSRC), 2002; DoE, 2003). This means that the only avenue open for the development of skills and knowledge within biotechnology would be at school level. Therefore, by foregrounding the third category of biotechnology, the NBSD seriously limits the use of biotechnology as leverage for human resources development to a privileged few. In contrast, the NCS-FET Life Sciences Policy foregrounds first- and second-generation biotechnology. How the NCS-FET Life Sciences Policy conceptualises biotechnology is brought to the fore in the next section.

1.4 Mapping the conceptualization of Biotechnology within the NCS-FET Life Sciences Policy

The NCS-FET Life Sciences Policy (DoE, 2006) embraces the concept of biotechnology as being first, second and third generation, espousing biotechnology as a continuum that extends from first-generation biotechnology (e.g. making of beer, wine, cheese, yoghurt) to third-generation biotechnology (DNA fingerprinting and cloning). The policy embraces a philosophy that biotechnology has been used for centuries by various cultures around the world. It acknowledges all three generations of biotechnology but foregrounds only the first and second generations for development of SKAV. Thus the content and SKAV advocated by the NCS-FET Life Sciences Policy focus on first- and second-generation biotechnology.

The disjuncture in the type of biotechnology foregrounded in the NCS-FET Life Sciences Policy and NBSD has serious implications for how biotechnology, via education, can be used as leverage for human resources development. Firstly, it translates or dislocates[2] the extent to which biotechnology can achieve this. Secondly, it negates the transformative agenda attached to the role of schools in terms of human resources and SKAV development. This disjuncture required that a preliminary study be conducted before the main study could be addressed.

1.5 Mapping the preliminary study

The questions guiding the preliminary research study were as follows:

- Whether industries using biotechnology have in their employment individuals with no tertiary qualifications (non-tertiary educated worker/s - NTEW).
- The level of the NTEW engagement in the application of biotechnology.

[2] Dislocate: Actors moved out of their intended path of action by some agent. The actor action is not as a result of their full consciousness (Latour; 2005, p. 43).

- Whether partnerships exist between the DoE, schools and industry, and the nature of these partnerships.
- How national educational policy goals are negotiated in these partnerships.

The preliminary study specifically focused on workers who do not have tertiary sector education and who are active in industries using the application of biotechnology. Data were constituted with the aid of a preliminary survey questionnaire and a semi-structured interview. These were used to trace who engages in the application of biotechnology in these industries, and in what capacities. The preliminary study (see Appendix B, pp. 169-186) illuminates a startling finding: that these six industries have more NTEW than tertiary qualified personnel involved in the application of biotechnology (see Table 1).

Table 1: Total number of employees and qualification of employees engaged in the application of biotechnology

Industry	Total No. of employees	No. with tertiary qualifications involved in application of biotechnology	No. of NTEW involved in application of biotechnology	No. of male NTEW involved in application of biotechnology	No. of female NTEW involved in application of biotechnology
A	105	45	60	50	10
B	110	20	90	70	20
C	105	5	100	40	60
D	75	5	70	45	25
E	135	15	120	40	80
F	310	60	250	120	130

This alerts us to a lurking crisis within the biotechnology industry in terms of qualified personnel. All six have both women and men NTEW involved in the application of biotechnology. Another interesting finding shown in Table 1 is that in three of the six industries (C, E and F) there are more female than male NTEW. These are two “food” industries and the pharmaceutical industry. This disparity is found at two levels, namely the gender level and level of the type of biotechnology used, which raises the question of how women are positioned within these industries using biotechnology, and whether women are being stereotyped in a patriarchal structure with respect to the skills required to engage with jobs in these industries. In this regard, it is interesting to note that these

industries require more than high-level skills, they also require intermediate skills, as depicted in Table 2.

Table 2: Entry-level skills for NTEW involved in application of biotechnology

Industry	A few entry-level skills for a biotechnology job
A	Observe, control variables, oversee experiments, follow instructions
B	Monitor experimental conditions, temperature/carbon dioxide level, pH, follow instructions
C	Take accurate readings/volume/temperature control, enzyme control, pH control
D	Read/write/communicate well, take accurate readings, control temperature, group work, give instructions
E	Measure correctly, set timer, control temperature, give instructions, check texture of dough/softness/volume/nutritional value, team work, follow instructions
F	Listening skills, people skills, observation skills, measuring and identification of compounds

The findings of the preliminary study debunk the myth that industries in this field have only tertiary-qualified personnel involved in application of biotechnology. The prevailing notion is that NTEW employed in these industries will and can only be involved in menial tasks. The findings from this study on who engages in application of biotechnology disclose the twofold nature of the NBSD's philosophy on how biotechnology can be used as leverage for human resource development. It is important to note that while the NBSD foregrounds third-generation biotechnology, the SKAV required to enact third-generation biotechnology differ from those required to enact first- and second-generation biotechnology. The industrialists in the preliminary study stated that their industries used mainly first- and (to a lesser extent) second-generation biotechnology. These divergences led me to establish the partnerships that exist between the DoE, schools and industry in terms of the NCS-FET Life Sciences Policy negotiation.

Partnerships were explored since a space has been created for civil servants to engage in the curriculum policy-making process (Naidoo, 2008). The findings of the preliminary study indicated that indirect partnerships exist between the DoE, schools and industry.

However, it is interesting to note that these partnerships exist at the level of sponsorship(s) between schools and industry, and have not extended to a curricular level yet. The curriculum policy-making process was traced through the DoE, school and industry node - specifically relating to the NCS-FET Life Sciences Policy and not policies in general. Three notions came to the fore:

- Methods of communication used during the policy-making process and their impact on policy negotiation;
- Involvement of stakeholders in the policy-making process as a result of methods of communication used; and
- Partnerships forged during the policy-making process as a result of methods of communication used.

The curriculum policy-making process is complex and involves actors from the DoE, Government, Department of Labour (DoL), DST, higher education, non-governmental organisations (NGOs), teacher unions and trade unions (see Appendix B, Annexure B10, p. 181 for details of those involved in the NCS-FET Life Sciences Policy). The method of communication used by the DoE during policy negotiation impacts strongly on the involvement of stakeholders. The findings of this study elucidate that policy negotiation involves socio-material interactions, i.e. interactions between human and non-human actors[3]. This means that materiality[4] cannot be divorced from human interactions.

Of particular interest is the DoE's perspective on its method of communication during curriculum policy reform. The DoE sees the use of the Internet as a means of communicating with and involving all stakeholders during policy negotiation. This electronic mode of communication is seen as an effective way to broaden access to policies and elicit public response. The teachers and industrialists see the DoE's method of communication as contradictory - and feel that it does not broaden access to policy negotiation. The excerpts below underline the reality:

[3] Actor: Something that acts or to which activity is granted by others. (Latour, 1997, p. 10).
[4] Materiality: Ability of an object to relate to (an)other object.(Sorensen, 2007, p. 24).

> *"I have no computer and no internet, I'm computer illiterate."*
> (Excerpt from teacher questionnaire Appendix B, Annexure B9, p. 179, response No. 7 to question 2.2)

> *"I don't visit the DoE website for the day-to-day running of my company. If they need our opinion they must ask us directly."*
> (Excerpt from semi-structured interview conducted at industry, Appendix B, Annexure B13, p. 187)

It is clear that the DoE's method of communication denied stakeholders access to engage in policy negotiation and limited their involvement during the curriculum policy-making process. The responses show that only a small, privileged sector of the teachers had access to Internet facilities, which leads to the following questions: how are teachers and industrialists being positioned by the DoE during policy negotiations? Can this curriculum policy space be accessed equally by all stakeholders? What initiatives are being implemented by the DoE to ensure that all its teachers are computer-literate and have access to computers?

The findings indicate that the DoE is oblivious to the socio-political factors that impinge on their communication strategy during curriculum policy negotiation. It would seem that the DoE sees curriculum policy negotiation as an insular process. Similarly, Manor (2004) and Buthelezi (2002) revealed that participation spaces established to channel citizen input are not accessible to the majority of the population.

When it comes to forging partnerships, problems arise due to the method of communication used by the DoE during the curriculum policy-making process. The DoE sees its method of communication with stakeholders as a way of forging a direct partnership with teachers and industrialists to aid in enactment of policy goals. The DoE believes that they are affording stakeholders an opportunity to take ownership of policy negotiation and development to enhance policy enactment.

While the DoE acknowledges that this privilege was not accorded to the public in the past, it is important to note that it has done nothing to build capacity among stakeholders to engage in the policy-making process of today. Neither was a democratic space for the engagement in the policy making process well advertised. It is noteworthy that teachers and industrialists have different perspectives to that of the DoE when it comes to partnerships. Teachers see their partnership with the DoE as being indirect, and occurring through subject advisors. Teachers emphatically stated that the subject advisors did not invite or encourage them to make input on the policy document during policy negotiation. There is a mismatch between the way the DoE construes the role of subject advisors and the actual role played by the advisors during policy negotiations. The excerpt below shows how the DoE constructs the role of subject advisors:

> *"Subject advisors are the coalface of curriculum implementation and negotiations and serve as conduits of policy negotiations."*
> (National Curriculum Developer, Appendix B, Annexure B11, p. 184)

Teachers see subject advisors as policy facilitators who cannot be questioned, and with whom policy cannot be negotiated. It is evident from the network tracing activity that there is a translation[5] in the roles that subject advisors play during policy negotiations. It must be noted that subject advisors are expected to serve as conduits for policy negotiation and development. Teachers' responses confirm a type of hierarchical relationship that exists between the DoE and subject advisors, and allude to a power relation that is perpetuated by the subject advisors. Subject advisors see themselves as the drivers of policy implementation, rather than as policy negotiators on behalf of the DoE. The process of tracing the negotiation of the NCS-FET Life Sciences Policy document uncovers a divergence between the DoE's view of subject advisors' functions and the actual role played by subject advisors during policy negotiations. The DoE seems unaware of translations enacted by subject advisors during the negotiation of curriculum

[5] Translation: process during which an actor persuades other actors in the network to try to redefine the goals of other actors and transform agendas (Latour, 1991, p. 25).

policy. It will be interesting to see whether this divergence in the role of subject advisors is perpetuated during policy mediation.

The findings of the preliminary study in respect of:

- the divergence in the type of biotechnology foregrounded by industry and the NBSD (DST, 2001),
- the divergence in the type of SKAV required by these industries,
- who engages in the application of biotechnology,
- the type and nature of partnerships between DoE, schools and industries, and
- the divergences in the National Curriculum Statement/Further Education and Training Life Sciences Policy negotiation process,

led to the main study - which explores the following:

- firstly, how the NCS-FET Life Sciences Policy is constructed and translated as it circulates across the DoE, schools and industry nodes; and
- secondly, whether there is an interface in terms of policy construction and constitution of SKAV across the nodes, and if so, what is the nature of this interface.

1.6 Mapping the use of Actor Network Theory

This chapter is entitled the "Cartesian Grid" in keeping with the metaphor of cartography which is borrowed from Latour's work *Reassembling the Social: An Introduction to Actor Network Theor*y (2005). A Cartesian Grid is normally used by cartographers to map out the topography of a country. During the mapping process the cartographer will look for signposts or landmarks to assist him or her in tracing the boundaries of a country. Latour relates the metaphor of cartography to research concerned with the tracing of networks. For Latour (2005), the use of the metaphor of cartography implies that there are no signposts or landmarks available to assist the cartographer in tracing

boundaries or networks: the implication is that the landmarks or signposts will emerge via the tracing of networks and associations. In using the metaphor of cartography, I hope to illustrate the complexity involved in the tracing and assemblage of networks at a methodological and analytical level in the rest of the dissertation. ANT (Latour, 1993, 2005; Callon, Law & Rip, 1986) is employed both as a theoretical framework and a basis for the methodology adopted in the preliminary survey and the dissertation.

ANT was developed by Bruno Latour, Micheal Callon and John Law. It was originally used by Callon (1986) to explore eco-social partnerships and power relations in the fishing industry in Paris. Callon considered both fishermen (humans) and scallops in the sea (non-human) as being actors that influence the success of the fishing industry. Although ANT has its origins in the field of science and technology, it is not restricted to this field and has become popular for understanding networks and social processes.

It has been used as a framework within management accounting (Cooper & Robson, 2006; Baxter & Chua, 2003; Briers & Chua, 2001; Lowe, 2001; McNamara, Baxter & Chua, 2004) and as a theoretical framework in studies in an interregnum phase, e.g. geographic information systems (Martin, 1999) and biodiversity studies (Rose, 2004), to predict trends. Studies in an interregnum phase serve as a model to describe how a phenomenon is going to unfold at grassroots level, before the occurrence or completion of the event. Sorensen (2005) employed ANT to describe and discuss forms of knowledge and presence performed through socio-material interactions. Kontopodis (2007) used ANT to investigate the fabrication of times in the concrete context of a school. Keeley and Scoones (2003) draw on this theory to understand environmental policy by means of selected case studies in Africa. Sommerville (2002) considers the usefulness of ANT as a theoretical and methodological approach to analysing development of an on-line socio-technical ensemble in the United Kingdom. Within the southern African context, Nhamo (2005) used ANT to investigate the emerging tensions, debates and responses arising from the policy on plastic bag regulation in South Africa. In all of the above ANT has been used to trace human and/or non-human networks at a single node.

In this study, multi-sited (Marcus, 1995) data constitution will allow curriculum policy construction and SKAV constitution to be visible as a networked emergent activity. The reform is performed in multiple locations and ways; in other words, curriculum policy reform can be thought about as nodes of practice performed by people and things. Therefore tracing and mapping the interface in terms of policy construction and SKAV constitution across the nodes is not a linear process. Multiple methods of data constitution are used across the nodes to trace the interface. Tracing of a phenomenon has not been done previously using ANT.

As a network tracing activity, ANT is used in the main study to trace:

1. How the NCS-FET Life Sciences policy is constructed and translated in practice as it circulates across the DoE, school and industry nodes:
   - How policy is constructed and which SKAV are constituted in practice at the DoE node.
   - How policy is constructed and which SKAV are constituted in practice at the school node.
   - How policy is constructed and which SKAV are constituted in practice by industry using the application of biotechnology by NTEW.
2. Whether there is an interface in terms of policy construction and SKAV development across the nodes, and if so, what the nature of this interface is.

1.7 Mapping the stage for the dissertation

The divergences found in the preliminary survey highlighted the challenge for structures such as the DoE, schools and industry to use biotechnology via the NCS-FET Life Sciences document as leverage for SKAV and human resources development. Put simply, this means that the transformative agenda attached to the developed curricula has implications for structures like the DoE, schools and industry. This transformative agenda invariably allows these structures to promote human resource development and overcome

skills shortages. The DoE, schools and industry then become the key elements in promotion of the transformative agenda. These structures are construed as nodes in the network developing SKAV. There is therefore a need to interrogate the nature of the link between the nodes within this network. While the links between the DoE, schools and industry seem obvious, this is an area that has been neglected. This led me to explore the interface between the DoE, schools and industry with regard to policy construction, practice and SKAV constituted across the nodes, in the context of biotechnology. To engage in this study and map interfaces I draw from the discipline of physics.

In physics the word 'interface' refers to "a meeting point between two media of different optical densities" (Dufresne, Gerace & Mestre, 2008, p. 2). The interface is construed as a meeting point between media of different optical densities. Here the interface is a meeting point (or point of convergence or divergence) among the nodes of the study. When a light beam travels between media of different optical densities, such as from air to glass or vice versa, two things happen at the interface - it is reflected and refracted[7]. In other words, the light beam experiences a translation in its direction of travel. It is this change that I am interested in exploring, particularly the change that is brought about by refraction. Knowing that the optical density of the medium determines the extent to which the light beam gets refracted, it becomes significant to ask what actually happens at the interface to cause the light beam to be refracted**.** The optical density of the node is determined by the f(actors) within the node. I then ask how the phenomenon of the interface is relevant to this study.

[7] Refracted: Bending of light beam as it passes between media of different optical densities (Dufresne, Gerace and Mestre, 2008, p. 2).

To map the interface between the DoE and schools, and schools and industry, the light beam is equated to the policy (NCS-FET Life Sciences) on SKAV development, while the DoE, school and industry nodes are equated to the media with different optical densities. This is illustrated in Figure 1 below.

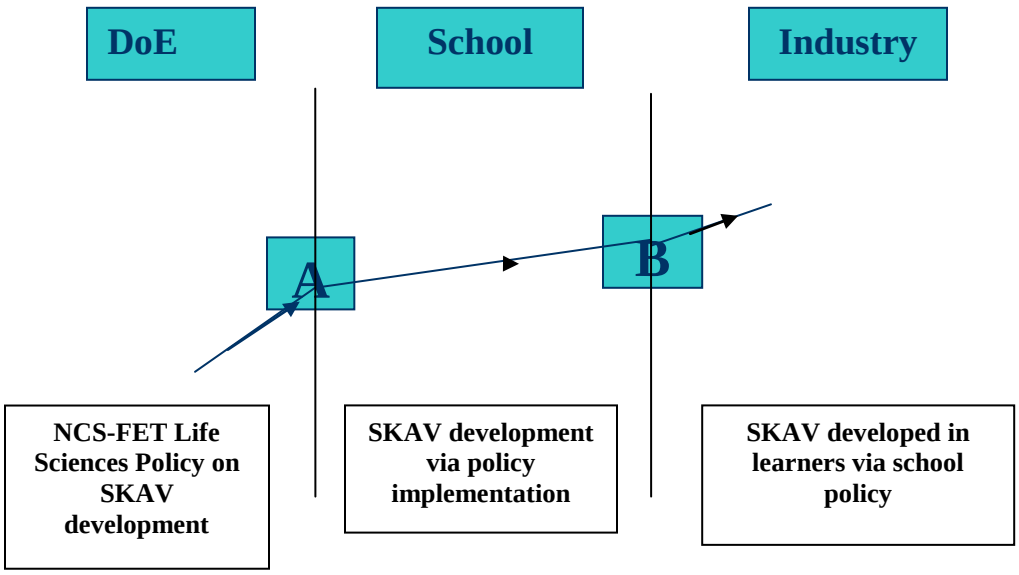


Figure I: Points of interface in this study

In the above figure there are two points, i.e. A and B, where the interface occurs. Point A represents the interface between the DoE and schools while point B indicates the interface between schools and industry. The degree of convergence or divergence that occurs at the point of interface will not be altered if the positions of the nodes are re-oriented on the figure above, i.e. (for example) if we begin with the industry node. Re-orientating the nodes in the figure does not alter the optical density of that particular node. It must be remembered that the optical density of the node determines the extent to which the NCS-FET Life Sciences Policy on SKAV development gets refracted. The emergent ray at the point of refraction takes a different path than the initial incident ray. The emergent ray is a product of refraction. The optical density of the medium contributes to the deviation of the emergent ray from its intended path.

This idea of interfaces, refraction and emergence allow us to see the emergent effect of the NCS-FET Life Sciences Policy as it traverses from one node to another. The process of "emergence" is the process of creation and change. The emergent policy is therefore constructed by actors during their engagement with the NCS-FET Life Sciences Policy.

To be able to trace and map whether there is an interface in terms of policy construction and SKAV development across the nodes, it becomes necessary to introduce the terminology of ANT to guide the tracing and mapping process (Latour, 1993, 2005; Callon, Law & Rip, 1986).

1.8 Mapping ANT's terminology

There are many terms associated with ANT; however, the following are crucial to aid our understanding of how ANT is deployed in tracing the interface with regard to SKAV development in this study.

Actor: According to Latour (1997, p. 10), an actor or actant in ANT is a semiotic definition, that is, "something that acts, or to which activity is granted by others". In other words, it implies no special motivation of human individual actors or of humans in general. Thus an actant can literally be anything, provided it is granted to be the source of an action.

Network: A network is defined as a "group of unspecified relationships among entities of which the nature itself is undetermined" (Callon, 1993, p. 263).

Translation: This is the continual displacement and transformation of actors; during translation actors change from who or what they are, to whom or what they want to be or become (Callon, 1986).

Mobilisation: A network starts to operate to implement the solution proposed, e.g. subject advisors mobilise teachers to focus on the exams (Latour, 2005).

Enrolment: This occurs when the principal actor defines the roles that are to be played and the way in which others will relate to one another within the network; e.g. the role of the subject advisor is defined by the national DoE, and subject advisors are expected to enroll teachers to implement the NCS-FET Life Sciences Policy (Law, 1992).

Enactment: Refers to the acting out of any activity that actors are enrolled into (Latour, 2005).

Mediation: Latour (2005) sees mediation as intervention offered by actors to bring about enrolment, enactment and translation in the network.

Interessment: This occurs when the principal actor locks the other actors into place and defines the linkage between actors, e.g. the national DoE expects the provincial DoE to train teachers and teachers are expected to implement the curriculum at schools (Callon, 1986).

Problematisation: This occurs when the principal actor defines the nature of the problem and proposes a way forward, e.g. the post-apartheid government identifies the backlog created by apartheid in respect of human resources development, poverty, job opportunities, redress and equity and proposes to use education as leverage for human resources (Callon, 1986).

Obligatory passage point: A point through which an actor must pass to maintain the network (Callon, 1986).

Intermediary: Actors that do not become full-blown mediators in the network (Latour, 1987).

Emergence: New networks that arise out of existing networks (Latour, 1987).

Convergence: Alignment of actors with other actors in the network (Callon, 1992).

Divergence: Non-alignment of actors in the network (Callon, 1992).

Contradictory cartographies: Agendas of emerging networks that oppose the agenda of the intended network (Latour, 2005).

Uncertainty: According to Latour (2005, p. 43), this refers to not knowing "who or what" makes us act. This means that action is not a result of actors' full consciousness as there are other unknown agents acting with them when they act.

1.9 Conclusion

In this chapter I assumed the role of a cartographer to map the topography for the study. The following concerns were raised:

- Divergence in the type of biotechnology foregrounded by the NBSD for South Africa (DST, 2001) and the NCS-FET Life Sciences Policy (DoE, 2003) on the use of biotechnology as leverage for human resource development;
- Industry's dissatisfaction with new workers' lack of skills (SCANS, 1991; JIPSA, 2007);
- The uncertainty of the roles of schools; and
- The NCS-FET policy's requirement for a curriculum to "meet the human capital needs of our country" (Dugmore, 2006, p. 7).

These concerns were addressed against the backdrop of ANT by engaging in a preliminary study. The study entailed tracing networks to answer the four research questions posed. The findings of the preliminary study debunk the myth of:

- who engages in the application of biotechnology;
- the type of biotechnology foregrounded; and

- the type of SKAV required by these industries (see Appendix B, Annexure B8).

The findings of the preliminary study led me to the main study. The main study explores how the NCS-FET Life Sciences Policy is constructed and translated as it circulates across the DoE, school and industry nodes and whether there is an interface in terms of policy construction, practice and SKAV constitution across the nodes. If so, what is the nature of the interface?

Chapter Two consists of two parts: Part A focuses on the distinctive tenets of ANT, while Part B reviews the literature from an ANT perspective.

CHAPTER TWO:

MAPPING THE THEORETICAL TERRAIN AND LITERATURE REVIEW

"*Social scientists have transformed the world in various ways; the point however is to interpret it*." Marx (cited in Latour, 2005, p. 42)

"*But to interpret it, we need to abandon the strange idea that all languages are translatable in the already established idiom of the social*."
Latour's response to Marx (Latour, 2005, p. 42)

This chapter comprises of two parts: Part A concentrates on the theoretical terrain, and Part B reviews the literature from an ANT perspective, or 'reviews the scripts'.

PART A:

MAPPING THE THEORETICAL TERRAIN

2.1.1 Introduction

In Part A I reflect on the challenges encountered in my search for a theoretical framework (2.1.2). I required a theoretical framework that allowed me to trace a shifting trajectory over multiple sites while placing the social under erasure (Latour, 2005) (2.1.3). ANT as explained by Latour (1987; 2005); Callon, Law and Rip (1986) and Law (2007) was a framework that satisfied the above criteria theoretically, methodically and analytically. In bringing to the fore the distinctive tenets of ANT, attention is paid to ANT's unique vocabulary, viz. actor, network, action, association and translation. It is necessary to unveil the theoretical implications of these terms since they are indispensable in the tracing (Chapter 3: Methodology) and assemblage (Chapter 4: Analysis) of networks. In using ANT as a theoretical framework, five uncertainties needed to be resolved, which are discussed in section 2.1.4.

2.1.2 Mapping the search for a theoretical framework

The search for a theoretical perspective to trace the construction of policy and the constitution of SKAV in practice was a challenge. To address my research questions I required a framework that could be deployed for four processes, namely:

- To approach curricula policy reform in terms of a networked activity;
- To trace how policy is constructed and enacted in practice;
- To allow for actors (human and non-human) to account for their actions, recount their networks and map their context, and
- To allow for the tracing and assemblage of associations in material semiotic networks created by actors.

In light of the above, the following theoretical frameworks were considered - Structuration Theory (Giddens, 1984), Activity Theory (Vygotsky, 1981; Nardi, 1996; Engestorm, 1987; Leont'ev, 1979), and Network Theory (Scott, 1994).

Structuration Theory (Giddens, 1984) was explored as a possible framework for tracing policy construction and translation in order to map interface as it focuses on concepts such as structure and agency. Closer examination of Structuration Theory revealed that it embraces a division between human and social objects, favouring human agency (Rose, 2004). This meant it would not be possible to map the interface by tracing the trajectory of the NCS-FET Life Sciences Policy as it traverses the DoE, school and industry nodes.

In Activity Theory (Vygotsky, 1981; Nardi, 1996; Engestorm, 1987; Leont`ev, 1978) the basic unit of analysis is an activity. A deeper examination of Activity Theory showed that the role of context in understanding the activity is crucial, since all activity is shaped by the context within which it occurs (Bertelsen & Bodker, 2003). Activity Theory favours the pre-existing context to explain the activity - it does not allow the actors to create the context that shapes the activity. Hence it could not be used to trace policy constitution and translation since policy traverses the three nodes of the study.

Network Theory (Scott, 1994) focuses on social relations between actors at different nodes. A closer examination of the concept of node within Network Theory showed that it is confined to humans and not structures such as the DoE, schools and industry (Wellman & Berkowitz, 1988). Therefore it also could not be used in this study.

Critical Theory was not considered as a theoretical framework as it makes an a priori assumption about power relations and emancipation. All of the above frameworks do not allow for policy to be considered as an actor; they favour human actors over non-human actors.

ANT, as explained by Latour (1987, 2005), Callon, Law and Rip (1986) and Law (2007), was considered a guiding framework which could be deployed to address the four processes mentioned above. Its distinctive tenets and conceptual resources allow for curricula reform to be considered as a networked activity. The distinctive tenets of ANT are elaborated in the next section.

2.1.3 Mapping the distinctive theoretical tenets of ANT

ANT is a distinctive approach to social theory which originated in the field of science and technology studies. ANT's distinctive approach to social theory makes it unique. So how is ANT different from other social theories?

2.1.3.1 Sociology of the social vs sociology of association

Latour (2005) argues that there are two distinct forms of sociology - traditional sociology, which he refers to as the sociology of the social, and then the sociology of associations. What differentiates theses two forms is that in the sociology of the social, the social (i.e. context) is taken as a given, while in the sociology of association, the social is produced via the actors and their associations (Latour, 2005). Hence, in the sociology of the social the actors are embedded in a context that is readily available to explain the phenomenon being explored (Latour, 2005). The implication of taking the social as a given to explain the phenomenon being explored is that it denies actors the opportunity to show how associations unfold or account for their actions. Furthermore, it prevents actors from making their own theories (ontology) of what constitutes the social. Therefore, in sociology of the social, the social does

not arise via the trails created by the actors (Latour, 2005). To support his argument Latour (2005) draws on Einstein's theory of relativity.

Originally it was assumed by physicists that there must be ether, or a medium present, for the propagation of electromagnetic waves. This presumed medium was thought to fill the universe. Einstein's theory of relativity, however, rejected the idea of ether being needed for the propagation of waves. Similarly, a problem arises when social scientists use the adjective 'social' to designate a stable state of affairs, which can later be used to explain some other phenomenon (Latour, 2005, p.1). This means it is acceptable for social scientists to comment on what is being assembled (Latour, 2005). For example, in assembling a group of girls, social scientists can comment on the girls' phenotype or outward appearance, i.e. height, colour of eyes and hair texture. Latour (2005) argues that a problem arises when social scientists aspire to the next level and comment on the nature of what is assembled. In other words, the problem arises when social scientists infer, for example, genotypic characteristics from what is assembled without focusing on the nature of what is assembled. It is in this regard, according to Latour (2005), that sociologists of the social fail to see that the social only becomes visible by the traces it leaves when new associations are produced between elements.

In contrast to the sociology of the social, the sociology of association approach sees the social not as a glue holding society together, but as something made up of human and non-human entities (Latour, 2005). These entities constitute networks of relationships (Latour, 2005); therefore, actors are never embedded in an overarching social context - they create the context by their associations or connection with other actors (Latour, 2005). In other words, in the sociology of associations the social is placed under erasure (Latour, 2005). Placing the social under erasure does not mean that the existing social context does not exist. The implications are that the overarching existing context is suspended and it cannot be used to explain a scenario as if it is applicable to all actors. Rather, the context should be allowed to emerge via the actors' actions, associations and the trails they create (Latour, 2005). This means that actors must be allowed to formulate their own theories regarding the structure of their social world (Latour, 2005, 1987). The tracing and assemblage of networks will illuminate how and why actors weave elements of "sociality[8] and materiality" (Mulchay,

[8] Sociality: Human actors and their influence on networks traced (Mulchay, 2005, p. 12)

2005, p. 12) into the very topography they chart. Therefore, in the tracing attention is paid to the associations among the actors.

It is these associations among the actors that reveal the hidden presence of social aggregates or forces. The sociology of association resumes the work of connections by engaging in the tracing and assembling of associations. To trace associations I have to firstly follow the actors and the trails they create (Latour, 2005). To assemble associations I have to juxtapose the actors' trails to allow the social to emerge via the associations formed (Latour, 2005). Thus the sociology of association is an ANT account of what practice occurs when a particular arrangement of socio-material elements are established in a network (Latour, 2005). It makes us ask how practice is constructed through this socio-material network (which SKAV are constituted in practice, how policy gets constructed and translated in practice, whether there an interface between policy construction and SKAV development and, if so, what the nature of the interface is). Drawing on ANT, curricula policy reform can be viewed as a field of socio-material practices (Harris & Marsh, 2005), and curriculum policy reform and SKAV development becomes an accomplishment of a network rather than of an individual actor (Latour, 2005). Since shifting associations among actors are traced, ANT is a mobile framework to travel with.

2.1.3.2 Mobile framework

The travel entails the tracing and assemblage of socio-material networks without making *a priori* assumptions of the impact of the social on the networks traced (Latour, 2005). ANT allows me to, firstly, travel the many networks created by the actors. Secondly, it allows me to trace the trajectory of the NCS-FET Life Sciences Policy over multiple sites. Thirdly, it allows me to gain insight into how actors account for their actions during network formation. Since socio-material networks are traced, ANT extends the analysis to both human and non-human actors. Such analysis brings to the fore convergences, alignments, strengthening of ties among elements in the network, divergence and non-alignments and weakening in the ties among elements in the network. An ANT analysis illuminates emergences within a network. The tracing and assemblage of networks is only possible due to ANT's unique vocabulary.

2.1.3.3. Unique vocabulary and theoretical implications for tracing and assemblage

ANT has a special vocabulary that is an integral part of the theory. These unique ANT terms are not insular or isolated, but are dynamic, interrelated and interconnected. They incorporate, embrace, shape and clarify each other in a relational manner. Together these extraordinary ANT terms are used in the tracing and assemblage of networks in this study. They jointly unravel and demystify the tensions, uncertainties, contradictions and relationships in the actor network - exposing the "networky"[9] effect of the actor network.

When one considers the word 'association' in the sociology of association, what comes to mind is that it denotes a particular definition of the social. The word 'social' is construed as all-embracing, including both human (social or subject) and non-human (material or object) actors. The term association inconspicuously unveils ANT's orientation towards the principle of general symmetry. Put very simply, this principle states that the categories of nature and society should both be explained from the same vantage points (Latour, 2005). This invariably means that the principle of general symmetry alludes to there being no dichotomy between objects and subjects. Consequently, by ANT embracing the principle of general symmetry, it bypasses the dualistic notion of modernity that divides our world into three purified categories, namely human and non-human, mind and body, local and global (Latour, 2005). Hence the principle of general symmetry has clear implications for how ANT conceives of what actors are.

According to Latour (1997), an actor or actant in ANT is a semiotic being, that is, "something that acts, or to which activity is granted by others" (Latour, 1997, p. 10). It implies no special motivation of human individual actors or of humans in general. Thus an actant can literally be anything, provided it is granted to be the source of an action. Therefore ANT allows for policy to be considered as an actor that can be followed. By the very nature of its definition of an actor, ANT proposes a theoretical shift in emphasis, away from the centrality and primacy of the human subject (Latour, 1999). Of particular importance is the fact that ANT grants agency to both human and non-human actors and is thereby considered to be non-dualistic.

[9] Networky: (the term I use to describe the interconnectedness of the multiple associations formed among the actors in the network

Agency in ANT terms refers to the capacity to cause an effect and make a difference to a state of affairs (Callon, 1986; Latour, 2005). ANT's orientation towards general symmetry allows me to trace the trajectory of the NCS-FET Life Sciences Policy as it traverses the nodes of this study. It also allows me to map the interface in respect of policy construction and SKAV development across the nodes. According to Latour (2005, 1999), by granting agency to both human and non-human actors we dissolve the uncertainty on the nature of objects. In doing so, we are able to see who the actors are in the phenomenon being explored and the ties they form with other actors in the network. The implication of embracing the principle of general symmetry is that by removing the divide between human and non-human actors, one is better able to scrutinise the nature of the interaction that forms the building blocks of networks (Latour, 1991). This eventually means that unsuspecting, behind-the-scenes actors involved in practice are illuminated. Therefore, to study the actors it is necessary to look into the relations involving them and the networks they create (Latour, 2005).

There are many conceptualisations of networks in the ANT literature. Networks can be seen as associations between actors, a trace that is left behind by a moving agent (Latour, 2005), as something within which "things" circulate, as connections between actors (Nespor, 1994) or as fluid spaces (Law, 2007). Networks can also be seen as producing and constitutive of material spaces of social practice and as channels of communication (Nespor, 2002). Furthermore, networks can be traced, described (Latour, 2005), and be seen as enacted (Mol, 2007). Most importantly, they can be seen as contextualising and generating the social and natural world (Law, 2007). Networks consist of nodes that are connected together by associations or more concrete links. Circulating in the networks are actors, mediators or intermediaries (Latour, 2005).

Tracing networks elucidates how socio-material elements participate in practice and what gets performed through their participation (Mol, 2007). These elements (for example, policy, hammer, scallop) show how network relations get enacted into practice (Mol, 2007; Law, 2004). ANT demonstrates that networks are outcomes that emerge from complex sets of relations among heterogeneous elements (Latour, 2005). Entities emerge as their associations are consolidated. In observing movement via shifting associations, we see relations to which we were previously oblivious. Not only is the actor coming into being, but the practice itself is brought to the fore, is reinforced, changed or reproduced. The actor and the practice are

interlinked. According to Mol (2007), an actor that is enrolled in practice is performed anew within each context and through each enactment

The question arises: how do we choose the actors we follow? In this study, the transformative agenda attached by the Government to educational reform in South Africa granted agency to structures such as the DoE, schools and industry. These structures aid in human resources development and overcoming the skills shortage. Furthermore, this transformative agenda also identified the actor that will be trailed in this study, viz. the NCS-FET Life Sciences Policy that will traverse the nodes of this study. Within each node there are many other actors that drive and move these nodes to deliver the NCS-FET Life Sciences Policy: for example, at the DoE node subject advisors, at the school node Life Sciences teachers, and at the industry node NTEW and mentors. The actors within the nodes are identified by their association with the NCS-FET Life Sciences Policy.

The actors and networks are mutually constitutive (Latour, 2005). Actors are seen as being a part of a network, and a network cannot exist without actors, nor can an actor exist outside a network (Latour, 2005). Both the actor and the network are important to allow for the unfolding of associations and to make the social apparent. The network and the actor are the starting- and end-point of the research (Latour, 2005). This means that the network reflects the work, practice, performance and relations of actors. In other words, the network highlights the practices of actors within the network of relations. Therefore, the network shows a type of relational continuity that is based on reciprocal relations between heterogeneous elements (Latour, 2005).

This implies a relational interplay among the actors in a network, and means the interconnectedness among actors is brought to the fore. For example, the NCS-FET Life Sciences curriculum is formulated at the DoE node, but is implemented and enacted at the school node. In this way, the DoE node is connected to the school node. The school node enrolls learners with SKAV and many of the learners enter the world of work. This means that the school node is linked to the industry node. In this way actors are connecting with each other - hence the interconnectedness among actors and nodes. Therefore, Latour (1999, p. 9) maintains that reality does not exist *per se*, but is constructed through the relational interplay between different actors in the network.

This means that the actors create reality in their interaction. Consequently, the relationships developed within the network dynamically shape and reshape and define the characteristics of the actors. Therefore, these actors affect each other in a complex web of interconnections which involve a process of mutual shaping. The actors are therefore not simply shaped by the network in which they are located, but also influence the other actors with which they interact (Law & Callon, 1997). Callon (1986) described the continual displacements and transformation of actors as translation.

During translation, actors change from who or what they are, to whom or what they want to be or become (Callon, 1986). Translation is the network process through which actors come into being. It highlights the practice of actors and how they must constantly work in relationships (Brown, 2002). Translation involves the process of mobilisation, enrolment, interessment and problematisation (Callon 1986). To trace the process of translation and use it as an analytical tool, actors must explain who they are, what they say or do, or who they want to become (Latour, 2005). It is only when this premise is met that Callon's translation can be used as an analytical tool.

Problematisation occurs when the principal actor defines the nature of the problem and proposes a way forward; for example, the post-apartheid Government identifies the backlog created by apartheid in respect of human resources development, poverty, job opportunities, redress and equity, and proposes to use education as leverage for human resources development. Interessment occurs when the principal actor locks the other actors into place and defines the linkage between actors - e.g. the national DoE expects the provincial DoE to train teachers, and teachers are expected to implement the curriculum at schools. Enrolment occurs when the principal actor defines the roles that are to be played and the way in which others will relate to one another within the network - e.g. the role of the subject advisor is defined by the national DoE, and subject advisors are expected to enroll teachers to implement the NCS-FET Life Sciences Policy. During mobilisation the network starts to operate to implement the solution proposed – e.g. subject advisors mobilise teachers to focus on the exams.

The focus is on how these actors use their influence within the network on other actors. The concept of mobilisation will allow me to accentuate issues of power dynamics, domination and personalities of the actors. Interessment involves convincing other actors to accept the

definitions, recruitment and practice provided by the focal actor (Callon, 1986). Hence, actors are not defined and analysed in a stable set of relationships in ANT, but according to the networks within which they are situated.

The advantage of tracing networks is that it dissolves the spatial dimension of inside or outside (Latour, 2005). The dissolution of this boundary allows for the exact nature of what lies within the network to be exposed, e.g. practice, policy construction, SKAV development, and the interface. Furthermore, it allows for the social to be momentarily suspended. This stance dissolves the notion of an overarching social to explain the phenomenon being explored (Latour, 2005).

What is worth noting from this particular perspective of a network is that I do not look outside a network to add or find an explanation for the phenomenon being explored – e.g. policy constitution and translation as it traverses the nodes of this study. The phenomenon being explored is what lies within the network. I trace the growth of the networks of policy construction and translation in order to assemble the nature of the interface. I do not need an explanation from an historical context hovering over the network in addition to the network's own historical growth. Thus network tracing allows for explanations to be made about related elements, or show how one element holds the actors together or forces them apart (Latour, 2005).

By following the actors within the network and allowing the actors to explain their actions, I dissolve the uncertainty about the nature of facts. This means that the actors account for their actions, unlike in the sociology of the social where the sociologist reports their actions using social aggregates. Each network, by growing, binds the materials around it. It is not possible to detect these materials by merely looking at the growth of the network. We have to trace the growth of the network in order to detect the materials (Latour, 2005). Therefore, according to Latour (2005), each network formed surrounds itself with its own frame of reference, its own definition of growth. To be able to engage in the tracing of network, I must first resolve uncertainties proposed by Latour (2005).

2.1.4 Resolving uncertainties

To resolve uncertainties I need to relate the uncertainty to ANT's unique vocabulary (Latour, 2005). As mentioned before, uncertainty in ANT terms refers to not knowing "who or what" makes us act (Latour, 2005). This means that the actor's action is not a result of consciousness as there are other unknown agents also acting when they act (Latour, 2005). According to Latour (2005) there are five uncertainties: the nature of group formation; the nature of action; the nature of objects; the nature of facts; and the type of study. These uncertainties need to be resolved before the tracing and assembling process can begin (Latour, 2005, p. 22). Therefore resolving the uncertainties becomes a precursor for the tracing and assemblage of networks. The fifth uncertainty is resolved by the uncertainty that underpins this study, namely the role of schools in preparing learners for the world of work.

In this study, therefore, four uncertainties have to be resolved. Latour (2005) maintains that if uncertainties are not resolved and we hurriedly begin to trace networks, we will have to turn to the social in order to explain the phenomenon under exploration. It is in this regard that Latour (1999, 2005) considers ANT's primary aim as that of describing the very nature of societies by tracing uncertainties.

The five uncertainties are linked to one another and intertwined in the network. In order to trace a network one constantly needs to resolve the uncertainties by relating one concept to another. Thus the tracing process is not conducted in a linear fashion – it is ongoing and comprises uncertain, shifting and heterogeneous ties (Latour, 2005). The network is a fluid space that changes around the actors in order to maintain the actors within the network (Law, 2004). The uncertainty of the nature of the object was resolved earlier when we focused on the principle of general symmetry espoused by ANT. The back and forth mapping among concepts leads to the formation of heterogeneous networks. This heterogeneity leads to the formation of contradictory cartographies, and brings to the fore the "heterogeneous nature of ingredients that make up the social" (Latour, 2005, p. 43).

The heterogeneous nature of the ingredients implies an uncertainty of "who or what" makes us act (Latour, 2005, p. 43), which deals with the nature of action. This means that action is not a result of our full consciousness, as there are other unknown forces acting with us. In

other words, action is not transparent; it is, as Latour (2005, p. 46) describes, “dislocated”. Latour (2005, p. 46) sees dislocation as a process in which actors are moved out of their intended path of action by some other agent. The actors respond to these agents over which they have no control. According to Latour (2005, p. 54), “agents are part of an account, they are accompanied by some explicit theory of action”. Put simply, it means that these agents dictate the actions of the actors. The actors either credit or discredit these agents in the accounts they provide about what makes them act. For us to illuminate the agents causing the dislocation, it is necessary to focus on the nature of the action.

The word ‘action’ is invariably intertwined with the word association, since action is a derivative from the associations or ties among entities (Latour, 2005). This means that action is the collective endeavour of many actors circulating in the network (Latour, 2005). Action is therefore a key term linked to associations; it brings to the fore the other actors enrolled in the network. The action among the associations results in displacements among the entities (Latour, 2005). The resultant displacement of entities changes the nature of the group. Due to the uncertainty of “what or who” makes us act, and the displacements that occur, we could never stabilise the social permanently (Latour, 2005). Once we shift our focus from certainty to uncertainty, we are able to trace what or who is acting and how group formation occurs. This leads us to resolve the third uncertainty, namely the nature of the group.

Latour (2005, p. 31) informs us that there are four important issues that need to be resolved for groups to form. These entail identifying a spokesperson for the delineated group, mapping the social context of the actors, assembling the traces by mapping fixed and durable boundaries, and lastly seeing the formation of groups as a joint activity (Latour, 2005, p. 31).

According to Latour (2005), the controversy with regard to group formation began with a question about which group is responsible for a particular role; for example, who is responsible for preparing learners for the world of work. Therefore we resort to tracing the relationships among all our actors when groups are formed**.** When groups are formed there are enrolments, tensions, uncertainties and translations that, which means that actors within a group and among groups are constantly relating to one another in an ongoing manner (Latour, 2005). This leads to ever-shifting ties or associations among the actors (Latour, 2005). These ties are fragile, uncertain and controversial. The implication of the shifting ties is that there

are no fixed relations, and the enquirer cannot confine actors to them (Latour, 2005). The enquirer thus follows the trajectory of an actor in the network.

To follow this trajectory, I focus on the tensions, uncertainties and translations among the actors when they form and dismantle associations. These tensions, uncertainties and translations provide the enquirer with the resources to render the social connection traceable (Latour, 2005). Thus, these shifting ties or frames of reference allow the social to become visible - and also lead to the formation of contradictory cartographies. These ties allow me to see aspects of the social impact on the actors' actions. Action is not transparent and has to be traced (Latour, 2005, p. 43).

Latour (2005, p. 31) maintains that to delineate a group is to define its boundary. To engage in this task we need a spokesperson for the group who will define the group and say what it should be and has been. The implication is that groups are not silent, but are the product of an uproar made by contradictory voices (Latour, 2005). It is the uncertainties among the actors that indicate which sociological theory the enquirer should use. Hence, it is unimportant to define in advance what sort of social aggregates provide the context for these maps.

The delineation of the group is the task of the actors. In other words, the actors do the sociology for the enquirer, and the enquirer learns from the actors what constitutes their sets of associations. Therefore, when associations are formed or are dismantled, their spokesperson tries to define them and the group's boundary gets marked, delineated and rendered fixed and durable (Latour, 2005). This means that the boundaries created by the spokesperson hold up against the contradictory pressure of all competing associations that threaten to dissolve the group boundary. Demarcation of boundaries results in a stabilisation period in respect of the associations, translations and group formations and the nature of action and object.

With regard to this study, the group has been delineated by the transformative agenda attached to curriculum development. As mentioned previously, this transformative agenda focuses on human resource development and overcoming the skills shortage in South Africa. The transformative agenda, attached to curriculum development, grants agency to structures such as the DoE, schools and industry to pursue the goal of human resource development and overcoming the skills shortage. Within each of these nodes there is a spokesperson that

defines, enrolls actors and justifies the existence of the group. In the section that follows I bring to the fore the spokespersons pertaining to the nodes of the study.

2.1.5 Spokespersons for the nodes

At the DoE node, the spokesperson is the NCS-FET Life Sciences Policy (gazetted policy and mediated policy) and subject advisors, while at the school node it is the Life Sciences teachers and policy since they are responsible for enactment of the curriculum. The NTEW are the spokespersons in the industry node since they are involved in the enactment of SKAV in these industries.

The spokesperson/s identified at each node will assist in mapping the social context by enrolling more actors into their practice. As mentioned in Chapter One, the optical density of the medium determines the degree of refraction experienced by a light beam traveling between media of different optical densities. It is important to remember that irrespective of which node the tracing begins at, the refraction that occurs at the node remains the same. When the spokesperson of the group alerts us to the tensions within the group, what comes to the fore is the optical density (composition) of the media through which the beam of policy travels. The spokesperson will further account for what caused the policy's construction to be refracted, and will highlight the extent to which the policy has been refracted.

2.1.6 Conclusion

In Part A of Chapter Two I explicated the challenge in searching for a theoretical framework that allows for the tracing of a moving target over multiple sites. The distinctive tenets of ANT, together with its unique vocabulary needed for the tracing and assemblage of networks, were discussed in the context of curriculum policy reform. From an ANT standpoint the social comprises associations between actors (Latour, 1986, 2005). It is these associations that foreground the action, tension, uncertainties, controversies and translations that actors encounter in the networks they traverse.

In Part B of Chapter Two I'll review the literature from the perspective of ANT.

PART B:

MAPPING THE LITERATURE REVIEW

2.2.1 Introduction

Another way of describing the literature review is as 'reviewing of scripts', in keeping with the metaphor of the actor from the theoretical framework. The scripts chosen to be reviewed were guided by the transformative agenda attached to education reform in a democratic South Africa, which grants agency to structures such as DoE, schools and industry to promote human resources development and overcome the skills shortage. The scripts reviewed therefore focus on studies that relate to the three nodes of this study - the DoE, schools and industry. The review brings to the fore the tensions, uncertainties and controversies in respect of the role of schools, curriculum policy reform goals and formation of partnerships.

2.2.2 Review of scripts

The literature that is reviewed is placed into categories which emerged from the different types of studies conducted and their focus. The literature was coded, and then placed into categories. From the literature consulted six categories were identified, namely studies that explore:

- The policy canopy in a democratic South African;
- Uncertainties of the role of schools in society (Bowles & Gintis, 1976; Giroux, 1991; Apple, 1992);
- Mismatches in the preparedness of learners for the world of work (JIPSA, 2007; Fish & Crossland, 1995);
- Networks between the school science curriculum and industry (Stephenson, 2000; Putsoa, 1997; Campbell, Lazonby, Miller, Nicolson, Ramsden &Waddington,, 1990);
- Overview of the NCS-FET Life Sciences Policy;
- Constitution of the NCS-FET Life Sciences Policy.

There are three types of challenges to education and curriculum development: internal challenges of an education system, challenges specific to workplace learning, and global economic challenges. These are pitched at three levels: the micro-level (school, DoE), meso-level (industry) and macro-level (global economy). The literature reviewed responds to the focus of this study and covers the micro and meso challenges. I am conscious of the literature available at the macro-level interrogating the effects of the global economic system on education (Sen, 1981). Competition within the global economy results in unemployment and inequalities (Daun, 2001) and accelerated science and technology development results in deskilling and unemployment (Becker, 1994; Burbules & Torres, 2000). However, the focus and research questions of this study did not create the space for literature pitched at the macro-level to be interrogated. In this way this study does, however, create opportunities for further research.

2.2.2.1 The policy canopy in South Africa

2.2.2.1.1 Platform for reform

Since 1994 there has been a "redesigning of the policy landscape" in South Africa in an effort to achieve a broad political shift from apartheid to a post-apartheid society (Jansen, 2000, p. 9). The apartheid system of education was plagued with inequalities, sexism, racism and autocracy, and characterised by rote learning, obedience, and a deliberate inculcation of misinformation and ethnic prejudices about Black South Africans, i.e. Africans, Indians and 'Coloureds' (Asmal & Wilmot, 2001). The new policies aimed to redress the huge backlog created in the apartheid era in terms of human resources development, reduction of poverty, improving literacy levels, job creation and competing in a global economy through the provision of quality education (DoE, 1998).

The Skills Development Act (DoL, 1998), the White Paper on Science and Technology (DoE, 1998) and the Human Resources Development Strategy: A Nation at Work (DoL and DoE, 2001) were introduced. Close networks were forged between the DoL, DoE and DST (Valley, 1998), which aimed to address the national imperatives of human resources development, improving literacy levels, broadening access into science and mathematics, overcoming the skills shortage, reduction of poverty, job creation and competing in a global economy (Valley, 1998).

The Skills Development Act refers to the people of South Africa as the country's most important asset (DoL, 1988), and to South Africa's past poor performance and ranking in respect of skills development and the systematic exclusion of Black South Africans from access to structured education and training programmes (DoL, 1998). It argues that nothing short of a skills revolution is required to overcome the imbalances created by apartheid education (DoL, 1998), and recommends that a new system in education with new incentives, learning programmes, institutions and personnel is required (DoL, 1998). It posits that improving individual educational attributes will lead to economic growth, especially in the field of science and technology. The White Paper on Science and Technology asserts that science and technology is vital for: human resources and economic, social and cultural development.

The newly formulated skills policies, the NBSD and the human resources development strategy of the post-apartheid government reflect tensions and contradictions in their goals. On the one hand they hope to compete in a global economy, while on the other they aim to attend to redress and equity. These two goals lie at the opposite end of a continuum. Uncertainty exists about the relationship between economic growth, equity and redress (Baptiste, 2001). The high skills, high knowledge approach to economic growth clashes with the goals of equity and redress (Baptiste, 2001). Beneath the high level of agreement between the DoE and the DoL about the integration of education and training policies lurks continuous tension about the details of this integration in practice (Baptiste, 2001).

The policies reflect the State's commitment to economic growth at the expense of access, redress and poverty alleviation for citizens long deprived of education, but little attention is paid to the implementation process (Jansen, 2000). This trend in government policies creates greater polarisation between rich and poor citizens, rural and urban communities and previously advantaged (White) and disadvantaged (African, Indian and Coloured) schools (Jansen, 2000).

It is difficult to combine social transformative goals with competing in a global economy. This will invariably led to injustices, and equity and redress will take a back seat. The

education reform process is supposed to be a vehicle for restructuring South African society along democratic principles; the State's vision is a victim of globalisation (Baptiste, 2001).

2.2.2.1.2 Initiation of reform

The refashioning of the education landscape that began in 1994 focused on the primary and junior secondary phases, and served as a scaffold for senior secondary phase policy formulation (Chisholm, 2004). During this cathartic process, teachers - who were trained in a racially stratified teacher education system (i.e. separate training colleges for African, Indian, coloured, and white), with different classroom practice and racially segregated DoEs - were unified under one administrative body in each province to embark on a journey of redress (Carrim, 2001; Chisholm, 2004; Jansen & Christie, 1999; Onwu & Stoffel, 2005). According to these scholars, the unification of all teachers under one administrative body meant that the multiplicity of teacher identities is ignored and that issues are dealt with in a generalised and homogenised way (Carrim, 2001). These studies remind us that once a teacher's pedagogical style has become entrenched; it has a resilience that is independent of change in government, curriculum policy reform or teacher training.

2.2.2.1.3. Structures of reform

There are nine provincial DoEs in South Africa that are accountable to the National DoE. The national DoE is responsible for policy formulation, and the provincial DoEs are responsible for policy mediation and implementation, service delivery and monitoring of education districts. According to Jansen (1999) and Onwu and Stoffels (2005), all major decisions pertaining to education are undertaken at national level, and the provincial DoEs are expected to heed the call of the national DoE. This divide has created vertical and horizontal incoherence between policy formulation, its mediation and implementation (Jansen, 1999). This disjuncture infers that having the same policy on paper does not mean that all provinces and their schools experience the same policy in use (Jansen, 1999; Carrim, 2001, Chisholm, 2004). The implication is that the capacity to implement policies is a missing element in the State's armory (Jansen, 2000).

There needs to be continuing dialogue between policy vision and practice if Government has serious intentions of changing the practice of education on the ground (Jansen, 2000). It

appears as though Government is preoccupied with setting policy visions in the political domain, rather than in the realm of practice (Jansen, 2000). Studies conducted by scholars such as Kraak (2000) and Chisholm (2004) alert us to the resources (human, physical, financial) needed for curriculum implementation.

Studies conducted by Samuel (2000) and Jansen (2000, 1999) reflect that the many efforts to alter the school curriculum within post-apartheid South Africa have relegated the responsibility of curriculum transformation to teachers. Furthermore, they maintain that the State has no clear understanding of the constraints and situatedness of teachers' daily practice. Samuel (2000) argues that context frames not only what is desirable, but also what is possible. The studies by Jansen and Samuel confirm that there are many surprising sets of agencies that need to be disentangled to ensure the smooth transition from policy formulation to policy implementation. At a theoretical level these studies confirm that actors are never alone when they act, and that their action is dislocated by many factors.

This raises very pertinent questions that apply to the teachers involved in this study. How can teachers teach a curriculum that they have never learnt, in ways they have never experienced? Put differently, this means that prominence is given to policy formulation rather than policy implementation. Policy formulation and implementation impact on teachers' classroom practice and their pedagogical identity.

2.2.2.1.4 Vacillations in curriculum policy reform

In post-apartheid South Africa, once policies are formulated, unsuspecting teachers are dispatched on a voyage of faith to implement these policies at schools (Malcolm, 1999). In a short period of 14 years, four new curricula were introduced by different Ministers of Education (South African Democratic Teachers Union (SADTU), 2004). Immediately after the 1994 elections the existing curriculum was purged of racial, sexist and outdated content. This was followed by C2005 (Curriculum 2005) in 1999. In 2000, C2005 was reviewed and revised into the Revised National Curriculum Statement (RNCS). Then the RNCS was revised and this eventually led to the formulation of the NCS-FET Policy that was introduced in the Further Education and Training (FET) phase in 2003 (Chisholm, 2005).

According to Harley and Wedekind (2004), these numerous curricula reforms indicate that there has been a very short time between the finalisation of the curriculum and its implementation. As a result of the time constraints, the national DoE instructed the provincial DoEs to provide a one-shot training session for practicing teachers using a cascade model.

2.2.2.1.5 Resultant dilemmas of curriculum policy reform

Studies conducted by Jansen and Christie (1999) and Chisholm and Narsee (2005) indicate that the introduction of a new curriculum heralds new responsibilities for teachers. This ultimately leads to an intensification of the teachers' workload. The above studies indicate the controversies and tensions teachers deal with due to curriculum reform. These scholars reveal that action does not depend on the performance of a single actor - there are many agencies that act when we act. Whenever a new curriculum is introduced, teachers are de-skilled and re-skilled.

According to Apple (1992), re-skilling contributes to anxiety about teachers' inability to implement the curriculum properly. Teachers question their "old" classroom practice and compare it to what is expected of them in the new curriculum. This creates a feeling of uncertainty and uneasiness among teachers about their knowledge and the classroom routine they have developed over a number of years. By engaging in the implementation of a new curriculum teachers are involved in many activities, such as teaching, planning new lessons, studying the curriculum documents, assessing learners' work, administration pertaining to the new curriculum and school requirements, counselling learners, extra-curricular work, and meetings (Hargreaves, 1992). These activities reflect the laborious process of teaching, and indicate the impact that curriculum reform has on teacher workload.

During curriculum policy reform teachers were expected to engage in curriculum development. Rather than following a prescriptive syllabus, teachers had to make decisions about what to teach and how to teach it. In South Africa teachers were expected to espouse the principles of Outcomes-Based Education (OBE) in their teaching.

2.2.2.1.6 OBE underpins FET curriculum policy reform in South Africa

OBE forms the foundation of the curriculum in South Africa (DoE, 1999). According to Malcolm (1999), Fakier and Wagheid (2004) there are three models for OBE, viz. traditional, transitional and transformative OBE. Traditional OBE is similar to the old approach to education, where the focus is on mastery of content (Malcolm, 1999). Fakier and Waghid (2004) are of the view that transitional OBE de-emphasises subject matter tests and factual recall as indicators of learners' success, and emphasises higher-order competencies. Transformational OBE is espoused by the education policies in South Africa, and aims to meet Government's goals in respect of transformation (Malcolm, 1999). It demands radical change in existing structures and operations at schools. It aims to prepare learners for the world of work and life in a rapidly changing society (Malcolm, 1999).

There are 29 learning areas in the FET section, with Life Sciences being one of them (DoE, 2003). Prior to the formulation of the NCS-FET Life Sciences Policy, the DST produced the NBSD. The DST asked the DoE to support biotechnology by including it in the science curriculum at secondary school level and at all teaching institutions (DST, National Biotechnology Strategy for South Africa, 2001). The National DoE then formulated the NCS-FET Life Sciences Policy document with the inclusion of biotechnology into the content. As indicated in Chapter One (sections 1.4. and 1.5), the NBSD foregrounds third-generation biotechnology, while the NCS-FET Life Sciences Policy foregrounds first- and second-generation biotechnology as a means for human resources development.

This means that each of these documents is not reconcilable in respect of the type of biotechnology foregrounded, the SKAV required to practice the type of biotechnology that is foregrounded and their plans for human resources development. Their objectives speak to different arrangements for the use of education as leverage for human resources development. This discrepancy exemplifies the tensions that pervade interpretation of the national goals and vision. It also has implications for how education can be used as leverage for human resources development. In these two documents lie the seeds of the contradictory nature of the human resource agenda.

The FET phase is located at the intersection of a range of policy and legislative imperatives, all aimed at addressing the compelling human resource development needs of the country

(Gewer, 2001). This sector should comprise a diverse array of education and training provision, both public and private, to deliver the 29 NCS-FET curricula. However, there are only 50 registered FET colleges in South Africa. As a result, the NCS-FET curricula in the various learning areas currently take place in senior secondary schools. In other words, FET sits at the crossroads between general education and training and higher education, as well as providing access to the world of work (Gewer, 2001). In a way, this heralds new roles and responsibilities for schools in South Africa. The role that schools should play in society is contested by many theorists, and is interrogated in the next section.

2.2.2.2 Uncertainties of the roles of schools in society

An underlying question underpins this study: should schools prepare learners for the world of work? Uncertainty arises from differing perspectives among theorists on the role of schools. These theorists' discourses could be placed into three categories of thought, based on whether they foreground the concepts of structure[10] or agency in their discourse: capitalist theory, reproduction theory and transformation theory.

2.2.2.2.1. Capitalist theorists

For capitalist theorists (Ricardo, 1817; Webber, 1904) the focus is on economic conditions, with the intention of making a profit. For these theorists the structure of the economy takes precedence over actors' action or agency. The implication of foregrounding economic structure over action or agency is that actors have no choice. Their future is determined for them by the economic structure. Furthermore, their position within this structure is also determined for them (Bessant & Watts, 2002). By emphasising economic structure, these theorists limit the degree of agency and power granted to the majority of the actors. Conversely, they grant a greater degree of agency and power to industrialists and the State.

From the perspectives of these theorists, schools are seen as institutions that should do the bidding of the economy and the State by producing a labour force that suits industry's requirements (Bowles & Gintis, 1976). They perpetuate the idea that actors are required to take on different work roles. As a result, these actors need different sets of skills, knowledge

[10] Structure: is a process that determines how actors act, it is not a steady fixed state (Bessant &Watts, 2000, p. 11).

and a particular disposition to go with it to suit the economy and the State. This implies a linear relationship between knowledge and power. Power is used to control what is deemed to be acceptable knowledge. This knowledge in turn reinforces those already in power (Freire, 1980). In other words, the State perpetuates power relations by distributing its citizens into various labour forces on the basis of the type of schooling they received and their educational qualifications.

Criticism has been leveled against capitalist theorists for foregrounding economic structure over agency by theorists such as Carspecken, 1998; Connell, 1996; Dewy, 1961; Freire, 1980; and Smyth, Dow, Hattam, Reid, and Shacklock, 2000. From the perspective of the above-mentioned theorists, schools are construed as being terrains of domination, which perpetuate an unequal society in terms of economic and social hierarchies and human resource development. In sharp contrast to capitalist theory is reproduction theory.

2.2.2.2.2 Reproduction theorists

Reproduction theorists (Apple, 1982; Bowles & Gintis, 1976; Carspecken, 1998; Connell, 1996; Dewy, 1961; Freire, 1980; and Smyth, Dow, Hattam, Reid, & Shacklock, 2000) foreground actors' agency in their conceptualisation of the role of schools. This means that in the relationship between structure and agency, agency is favoured. From the perspective of these theorists, schooling is not merely about knowledge and skills but rather a process fostering values, attitudes and creative and emotional development, all of which contribute to "responsible, active sound productive citizenship" (Apple, 1986, p. 107). For these theorists the premise is to preserve the treasures of civilisation within the process of socialising the members of each new generation.

In addition, these theorists argue that it is not the job of the school to prepare learners for the job market and reproduce the economic, social and cultural patterns of the Government. They base their argument on the foregrounding of agency over structure in their conceptualisation of the role of schools. These scholars are conscious of the dynamic relationship between knowledge and power; for them, the relational interplay between knowledge and power is highly conspicuous. Thus they perceive schools as tools used by the State to perpetuate power relations between industry, the State and its citizens, with the dynamism between these players determining the nature and purpose of what it means to be educated.

What is worth noting about this perspective is how power is perceived. These scholars construe power as a control mechanism that is used to perpetuate domination and social injustice (Wang, 2003). In contrast to the reproduction theorists are the transformation theorists.

2.2.2.2.3 Transformation theorists

Transformation theorists (Aronowitz & Giroux, 1991; Giroux, 1991; and McLaren & Farahmandpur, 2000) foreground both structure and agency as joint partners in their conceptualisation of the role of schools. What distinguishes these theorists from capitalist and reproduction theorists is how they view power. Of particular relevance is the notion of power as having a dialectical character; they see it as a mechanism that can be used to repress or control people - or to emancipate people. It is in this regard that Giroux (1991) argues for use of the curriculum as a tool to address issues of social justice, develop critical citizenship or address disadvantaged cultural and economic capital. From this perspective, schools are seen as vehicles for a qualitatively better life for all via the curriculum being taught.

South Africa, a relatively new democracy, has adopted a democratic, transformatory perspective on the role of schools. This perspective is strongly aligned with the transformation theorists, and sees power as having a dialectical character that can be used to emancipate people. Education is one of the few forces with the potential to mitigate the negative affects of apartheid and the inequalities it perpetuated. In South Africa schools are seen as vehicles to assist with the transformation agenda and in preparing learners for the world of work (Naidoo, 2007; Dugmore, 2006; Masango, 2007), address backlogs in human resources development to overcome the skills shortage (Bhorat, 2000), promote competitiveness in a global economy, develop critical thinking and address issues of social justice, equity and redress (DoE, 2003; Dugmore, 2006; Masango, 2007).

It is worth noting that the development of human resources is construed as a need - a commodity needed to improve quality of life directly (Sen, 1981). Curricula have been revamped in an effort to overcome the legacy of apartheid and redress imbalances in the context of racial, gender and human resources development. Within the democratic context the State is construed as an agent of change. In other words, it occupies the dialectic space

between socio-economic redress and economic growth. Since schools are seen as vehicles to assist with the transformation agenda as well as preparing learners for the world of work, in the section below I review literature on the preparedness of learners for the world of work.

2.2.2.3 Mismatches in the preparedness of learners for the world of work

There is ample literature on youth transition, employment and industry expectations. Industry has expressed concern about the mismatch between SKAV acquired at educational institutions and those needed in industry (SCANS, 1991; Johnson, 1999; HSRC, 1995; Phillips, 1995; Lee, 2003; and JIPSA, 2007). Claims have been made by various commissions and employer groups that:

- schools are not preparing students appropriately for changing technological requirements and increased worker responsibilities (SCANS, 1991; Kazis, 1993; Poole, 1985);
- many graduates from universities and technikons (now Universities of Technology) show little evidence of developed skills, and few were able to make a significant contribution in the workplace without further training (HSRC, 1995; Phillips, 1995; and JIPSA, 2007);
- there is a need to re-educate new recruits when they enter the world of work with regard to SKAV used in industry (Lee, 2003; Fish & Crossland, 1999; Doblin, 2001; Buchanan & Sullivan, 1996); and
- many students who complete their studies in science with apparent success still lack any familiarity with the scientific ideas they encounter in the real world of work (Fensham, 2003).

The effective running of any industry hinges on skilled manpower available at a management, research and operational maintenance level. The studies cited highlight industry's expectations of schools in respect of preparing learners for the world of work. Malcolm's (1999) study confirms that industry is calling for skills it did not demand 50 years ago, such as critical thinking, problem-solving, teamwork and self-management. These skills were not previously considered to be highly desirable. Malcolm infers that the demand of industries in respect of SKAV is shifting, and is translated due to advancement in technology and

competition in the global economic market. Hence industrialists see a direct relationship between the types of SKAV developed at learning institutions, the employability required by industry, and the resultant workplace training that has to occur (Malcolm, 1999).

These above studies all focus on learner unpreparedness for the world of work. They do not clarify which SKAV are needed in these industries. They claim that industry needs to re-educate new recruits when they start work, and that this re-education impacts on their budgets and productivity levels. Yet schools continue to be unaware of the skills needed, and of their new role and responsibility to prepare learners for the world of work. Therefore a communication void exists between industries and schools.

This study seeks to assist in closing this communication gap by forging links with industry and creating an awareness of the SKAV required. It would seem that the absence of partnerships between learning institutions and industry has been a great contributor to learner-unpreparedness for the world of work. Forging partnerships will allow for better channels of communication and collaboration between learning institutions, curriculum development and implementation, and industry.

If education is to act as leverage for human resource development, closer collaboration is needed between the DoE, schools and industry. It is necessary to clarify how the school science curriculum reflects or mirrors what is needed in industry in respect of SKAV. In the next section I focus on networks between the school science curriculum and industry.

2.2.2.4 Networks between the school science curriculum and industry

A plethora of studies have been conducted both in the North (Yager, 1980; Campbell *et al*., 1990; Brandt, 1993; Nicolson & Pilling, 1993; Stephenson, 2000) and the South (Manyatsi, Lubben & Campbell, 1992; Mensha, 1994, 1995; Putsoa, 1997) to contextualise the school science curriculum. These studies aimed to contextualise the curriculum by forming a link between school science and the application of scientific knowledge in industry and everyday life. Yager's (1980) research in the United States of America shows that the science, technology and society approach could lead to an improvement in the participation, motivation and attitude of learners. This research initiated further reform in contextualised

school science, and consequently science became more accessible to a greater number of learners.

Campbell *et al.* (1990) implemented curriculum initiatives for students aged 11 to 19 years with the Salter's Science Project. This project was initiated in response to a call by the Department of Education and Science (1985), the Association for Science Education (1981) and the Royal Society (1982) in the United Kingdom, for science to be taught to all school children during the period of statutory education (children aged 5-16 years). The call stipulated that the curriculum should be broad and balanced, with an emphasis on content and the process of inquiry.

The different premises for curriculum development in the Salter's Science Project and post-apartheid South Africa (specifically the NCS-FET curriculum) are fascinating. The Salter's process created an awareness of the application of science in industry, while the purpose for curriculum reform in South Africa is to address the ills of apartheid (DoE, 2003; Bhorat & Oosthuisen, 2006; Naidoo, 2007; Dugmore, 2006). These different premises illustrate that different forces underpin curricula reform in the North and South.

The two goals of the Salter's Science Project were to develop new ideas for improving the teaching of chemistry and to develop young people's awareness of the chemical industry. The design of the process relied heavily on the knowledge of experienced school science teachers and industrialists. During the process the designers of the project considered the following theoretical ideas and perspectives:

- theories about the selection of curriculum content;
- theories about how young people learn; and
- theories about educational change.

In this respect, it is interesting to note that the theoretical underpinning that guided curriculum reform in post-apartheid South Africa was aimed at "social redress and equity in the provision of quality education" (DoE, 1998, p. 34).

The Salter's Science Project programme consisted of four detailed science courses, complete with teaching material, assessment and certification schemes:

- Science focus: A course covering all areas of science for ages 11-14
- Science: A course covering all areas of science for ages 14-16
- Chemistry: A course covering a chemistry programme for ages 13-16
- Advanced Chemistry: A course covering a chemistry programme for university entry, ages 16-19.

The rationale for developing material for the four science courses was to provide the student with an authentic picture of science and its role in people's lives, and to encourage students to connect their learning with their lives. More than 500 schools in the UK used these programmes in 1991.

In 1994 Campbell *et al*. evaluated the success of the project through interviews with teachers and students. In the end, the success of the Salter's Science Project was based on the number of students that pursued the programme. It was found that the number of students pursuing the Salter's GCSE Science Course and GCSE Chemistry Course increased during the period 1992-1994. This tells us nothing about the intervening process, however in addition, it raises the question of reliability of the methods used to obtain data. The evaluation of the success of the Salter's Science Project does not deepen our understanding of the theoretical underpinning (see above) that formed the basis of the project. The increase in the number of students could be attributed to science becoming a compulsory subject for all students up to the age of 16 in England and Wales.

In spite of the methodological limitations of the study, it is interesting to note the kind of partnership that was formed between school teachers and industry. Teachers received support from industry, which helped make the curriculum more real. Teachers were trained by industry to teach a contextualised curriculum and they received support materials. Stephenson (2000) conducted similar studies, the primary goal of which was to develop new ideas for improving the teaching of chemistry. The reputation of the chemical industry was enhanced by developing a range of educational activities and resources, by promoting partnerships between schools and industry, and by organising in-service training for teachers.

Studies have also been conducted in southern Africa. Putsoa (1997) conducted a study in Swaziland on bridging the gap between school science and technology and local industry. This project was known as LISSIT (Linking School Science with Industry and Technology). The LISSIT project aimed to meet the demand for science curriculum reform that would meet industry's needs. The intention was to make teachers aware of industrial processes and to train them in the teaching of these processes. Mensha (1994) initiated the Science and Technology in Action (STAG) project in Ghana. This aimed to bridge the gap between the science taught in school and that practiced in industry and other areas of everyday life. Mensha (1994) found that science teachers themselves lack an awareness of the industrial processes around them, and have little or no knowledge about the raw materials, sources and production processes underlying common products such as paper, chocolate, soap and toothpaste.

A partnership was developed between education and industry and led to the production of teacher resource books and support materials for learners. Industry was an important partner in the development of resource materials, an initiative that departs from the usual pattern of curriculum development in Ghana. The development approach included industrial visits, workshops and feedback mechanisms. This empowered both teachers and industrialists. The involvement of the industrialists together with teachers, researchers and policy-makers resulted in creation of a broader community of knowledge producers. Mensha's study highlights the need for collaboration among stakeholders during curriculum development and reform.

The findings of our preliminary survey echo the absence of industrialists from curriculum development (see Appendix B, Annexure B11, p.163). This idea is worth exploring in South Africa.

Mensha's study maps the boundary for forming a real link between what is happening in school science and what is happening in industry. The study illustrates that the premises behind curriculum development in Africa are very different from curriculum development in Europe and the developed world. The studies conducted in the West revealed that curriculum initiatives are implemented to facilitate and enhance the understanding of the learner and improve the teaching of science. In Africa, curriculum development centres on issues of

social and economic development - and not enhancing understanding or improving the teaching of science. In other words, it should allow for learners and stakeholders to "use their scientific knowledge for their growth or the welfare of the country" (Mensha, 1994, p. 55). One could argue that, to an extent, South Africa is in a similar predicament.

Another interesting notion is the effort made to support teachers during curricula reform. These studies attached immense value to forging a partnership with industry and to the support teachers received from industry. This partnership led to the production of teacher resource books and support materials for learners. It empowered both teachers and industrialists, and their joint involvement with researchers and policy-makers resulted in the creation of a broader community of knowledge producers. These studies highlight the need for collaboration or networking among stakeholders during the development and implementation of the curriculum. Forging a curricula partnership with industry serves a twofold purpose: it supports teachers in implementing the new curriculum, and helps ensure its successful implementation.

These studies value the philosophy of partnerships, but do not provide any documented strategies on how to go about forging and maintaining partnerships. They highlight the *ad hoc* nature of formulating a partnership. The findings from our preliminary study indicated that teachers and industrialists lacked the "know how" on forging partnerships (Appendix B, Annexure B9, question 4, response No. 9, p. 177). It is my intention to contribute towards the discourse on forging partnerships between learning institutions, the DoE and industry. The forging of a partnership between stakeholders is essential to promote human resource development. Having local industrialists design resource materials for curriculum development is worth exploring in South Africa, and could aid in facilitating SKAV development as a collaborative venture.

2.2.2.5 Overview of the NCS-FET Life Sciences Policy

Designing of the NCS-FET Life Sciences Policy began in 2003, and it was introduced in schools in 2006. This latest policy document is conceptualised with the imperatives of: human resource development, democracy, competing in a global economy, redress and equity (DoE, 2003). The introduction of the NCS-FET Life Sciences Policy is in keeping with global trends of technologically advanced societies where much emphasis is placed on science and technology education (Fiske & Ladd 2000).

The NCS-FET Life Sciences replaced the Nated 550 Biology Policy (National DoE, 1992). The Nated 550 policy was based on the principles of Christian National Education, and did not allow evolution to be included in the curriculum or taught at schools. It did not embrace the principles of equity, social justice and democracy, human resources development or indigenous knowledge systems (IKS). The Nated 550 Policy provided differentiation via Higher Grade and Standard Grade syllabi and examination papers (DoE, 2003). Learners' identities (personal and academic) were then constructed in accordance with the grade at which they took a subject at school level. Differentiation catered for and showed learners' achievement at different levels across the learning spectrum. Differentiation was used as a mechanism for selection of learners for entry to higher education.

The NCS-FET Life Sciences Policy was formulated by the National DoE in response to the democratically elected Government's call for a transformatory agenda to be attached to education (DoE, 2000). This agenda aims to address challenges in terms of human resource development, overcoming the skills shortage, reducing poverty, job creation, equity, social justice, democracy, and recognising IKS. The National DoE used national and provincial curriculum developers, personnel from tertiary institutions and NGOs and teacher union representatives (seven out of the nine of whom were absent from these meetings) to design the policy. The public were expected to contribute to the policy design process via the Internet (see Chapter One, section 1.5 for more discussion on methods of communication during the policy-making process).

The NCS-FET Life Sciences Policy consists of four (see below) chapters and 77 pages. Chapter one describes the principles, the kind of teachers envisaged, the kind of learners

envisaged, and design features of the policy (see Appendix C, Annexure C5 for elaboration of the NCS-FET Life Sciences Policy, p. 201). The Policy espouses the principle of OBE, which means it has constructed an image for teachers and learners. Teachers are expected to be competent, qualified mediators of learning, leaders, scholars, community members, and subject specialists who are dedicated and caring (DoE, 2003). They are expected to be developers of curricula material at a local level and not just implementers of policy (DoE, 2003). Teachers are expected to embrace innovative constructivist teaching approaches in their classrooms in order to promote the development of critical thinking and problem solving. Learners emerging from the FET band must have access to good- quality education, demonstrate an ability to think logically, analytically, holistically and laterally and be able to transfer skills from familiar to unfamiliar situations (DoE, 2003).

An introduction to the Life Sciences learning area is provided in Chapter two, which describes the definition, purpose, scope, career links and three LOs which the NCS-FET Life Sciences Policy aims to develop in learners: These LOs are unpacked in Chapters Three and Four. LO1 is concerned with scientific inquiry and problem solving; LO2 focuses on construction and application of Life Sciences knowledge; and LO3 emphasises understanding the interrelationship of Life Sciences, technology, the environment and society. Each LO has three assessment standards (ASs) which reflect the competencies derived from the critical and developmental outcomes of the Constitution of the Republic of South Africa that need to be developed in learners (DoE, 2003).

The Policy enshrines democracy, OBE, high skills, high knowledge, and displays a post-modern view of human resource development. What do these sentiments imply for how we construe and formulate our LOs, and what are the implications for using education as leverage for human resources development?

2.2.2.6 Constitution of the NCS-FET Life Sciences Policy

The findings of the preliminary study (see Chapter One, section 1.5) signal that in South Africa, policy formulation involves contestation over ownership. The methods of communication used remain a major source of tension between the DoE, teachers, industrialists and the general public.

The constitution of the 29 NCS-FET policies (there are 29 learning areas) was guided by the critical and developmental outcomes of South Africa's Constitution. According to Nzimande[11] (1997), the key competencies reflected in the critical and developmental outcomes of the Constitution were not determined by arbitrary decisions about what personal qualities and cognitive skills are desirable, but by careful consideration of the prerequisites for a well-functioning democratic South Africa. The guiding question, according to Nzimande (1997), was what demands our new democratic society places on its citizens.

This demand-led approach asks what individuals need in order to function well in society, what competencies they need to find and hold down a job, what kind of adaptive qualities are required to cope with changing technology or demands, and what qualities are needed for individuals to actively engage in political, societal or environmental issues (Nzimande, 1997). The competencies identified in the critical and developmental outcome reflect our national goals for transformation in a democratic South Africa, and form the foundation of the LOs in each learning area (Nzimande, 1997). An LO is a statement of the intended result of learning and teaching (DoE, 2003). It describes the SKAV that learners should acquire in the FET band, and the SKAV teachers should engage with in their teaching (DoE, 2003). The critical and developmental outcomes thus constitute the key competencies for LO1, LO2 and LO3, as reflected in table 3 below:

Table 3: Relationship between Life Sciences LOs and the critical and developmental outcomes

NCS-FET Life Sciences LO	Associated critical outcome	Associated developmental outcome
LO1: Scientific inquiry and problem solving	• Identify, solve problems using critical and creative thinking • Collect, analyse, argue and critically evaluate information • Communicate effectively using visual, language, symbolic and other modes	• Reflect and explore a variety of learning strategies
LO2: Construction of knowledge	• Use science and technology effectively and responsibly towards the environment • Organise, manage themselves and their activity responsibly and effectively	• Participate as responsible citizens in life of local, national and global communities. • - Explore education and career opportunities

[11] Nzimande: Was appointed in 2009 as Minister of Higher Education and Training in South Africa.

	• - Demonstrate an understanding of the world as a set of related systems recognising that problem solving contexts do not exist in isolation	
LO3: Understanding the interrelationship of Life Sciences, technology, the environment and society	• Work with other members of a team, group, organisation • - Use science and technology responsibly towards the environment	• Participate as responsible citizens in life, natural and global communities • Be culturally sensitive across a range of social contents • - Develop entrepreneurial opportunities

Source DoE, 2003, p. 15.

In the constitution of the NCS-FET Life Sciences Policy, which espouses transformational OBE, curriculum developers drew on the work of Bloom (1956) and Padilla (1990) to clarify the competencies for each of the three LOs (Naidoo, 2009). Padilla's work was drawn upon by the curriculum developers, since it envisaged that science comprises three parts, viz. science processes (investigation, practical work); scientific knowledge construction; and scientific attitudes and values, which corresponds to the three LOs of the NCS-FET Life Sciences Policy (Naidoo, 2009). Padilla's three components of science gave rise to the acronym SKAV that is used by the NCS-FET Life Sciences Policy as well as the RNCS document.

Bloom's taxonomy was used as it had been used in our curriculum development in the past (Naidoo, 2009) -it forms the foundation for the LO2, competencies while Padilla's science process skills underpin the competencies of LO1 and LO3 (Naidoo, 2010). The NCS-FET Life Sciences Policy enshrines democracy, transformational OBE, critical thinking and problem solving, yet its constitution is guided largely by behaviourist and cognitivist principles. Herein lies the divergence and contradictions in policy constitution. Bloom's taxonomy is antithetical to the constructivist principles and social transformative agenda that grounds OBE in South Africa.

Bloom's taxonomy has influenced curriculum development, the construction of test and exam questions and our understanding of LOs (Naidoo, 2009). It helps teachers to match the questions they ask with the type of thinking skills they are trying to develop in learners, and to formulate instructional objectives (Naidoo, 2009). Bloom, an educational psychologist, identified three domains of educational activities: cognitive (knowledge), affective (attitude)

and psychomotor (skills). Knowledge, according to Bloom (1956), is what is learnt and needs to be tested. Bloom's taxonomy originated in an effort to make assessment more systematic. This is based on the premise that there are distinct thinking behaviours that we engage in that are important in the learning process. These thinking behaviours within the cognitive level were arranged by Bloom into six categories that ascend in their level of complexity from knowledge and comprehension at the lower levels, to application, analysis, synthesis and evaluation at the higher levels.

This scheme orders the six categories into a hierarchy such that cognition at each level encompasses, builds on and is more difficult than that at the level below it (Naidoo, 2009). The affective domain includes the manner in which we deal with things emotionally, e.g. feelings, appreciation, enthusiasm and motivation. It also includes values, e.g. the value a person attaches to a book (Krathwol, Bloom & Masion, 1978). The psychomotor domain includes physical movement, co-ordination and the use of motor skills (Simpson, 1972).

Bloom's taxonomy gave rise to the acronym KSA, which represents each domain in the taxonomy. In this study I will pay attention to the cognitive domain of Bloom's taxonomy since it forms the foundation for LO2 competencies. In determining the competencies for LO2, the six levels of Bloom's cognitive domain were compressed into four levels, viz. knowledge (recall); comprehension, application and analysis; synthesis; and evaluation; as depicted in the table below by the curriculum developers, to facilitate testing (Naidoo, 2009). LO2 focuses on knowledge construction and entails the following nine competencies: collecting and accessing information, identifying concepts, describing and explaining concepts, comparing, organising, evaluating concepts, interpreting, analysing, and applying Life Sciences knowledge to everyday life.

Table 4: Cognitive levels of Bloom's taxonomy and the NCS-FET Life Sciences Policy

Bloom's taxonomy		NCS-FET Life Sciences Policy		
Level	**Cognitive domain**	**Level**	**LO2 levels of testing and AS**	**Identification term/s**
1	Knowledge	**1**	Knowledge - AS1	- Collecting and accessing information
2	Comprehension	**2**	Comprehension - AS2	- Identifying concepts - Describing - Explaining concepts
3	Application	**3**	Application and analysis - AS2 AS3	- Comparing - Interpreting - Analysing
4	Analysis			- Applying concept to everyday life
5	Synthesis	**4**	Synthesis and evaluations AS3	- Organising evaluation of concept
6	Evaluation			

The action verbs or noun associated with each cognitive level allow us to empirically identify the LO engaged and the competency being practiced.

Padilla's (1990) hierarchy of science process skills was used to clarify the competencies for LO1. According to Padilla (1990), a skill refers to the ability to demonstrate or enact a competency during science processes. Science process skills are categorised as basic and integrated (Padilla, 1990). Padilla (1990) maintains that basic science process skills form the foundation for learning integrated science process skills.

Table 5: Padilla's science process skills and LO1 competencies of the NCS-FET Life Sciences Policy

Padilla	Science process skills	Associated AS of LO1 in NCS-FET Life Sciences
Basic process skills (7)	Follow instructions, Observation, Measurement, Identification, Record, Classification, Plan investigations	**AS1**
Integrated process skills (21)	Asking questions, Hypothesis, Formulating and designing experiments, Manipulation of apparatus, Selection of materials, Organisation, Presentations, Translation of data, Making predictions, Recognition of problems in experimental designs, Construction of models, Recognising trends, Making inferences, Conclusions	**AS2**
	Evaluations, Application, Making deductions, Analysis, Reflection on reliability and validity, Synthesis, Critique experimental designs/models	**AS3**

Skills can be empirically identified when learners demonstrate, engage or practice any of the competencies listed in the above table.

To clarify the competencies for LO3, Padilla's work was used once again in conjunction with the critical and developmental outcomes of the South African Constitution.

Table 6: LO3 competencies

Padilla – Competencies for attitude and values	Critical and developmental outcomes competencies for attitudes and values
Ethics in research	Awareness of IKS
Respect other's views	Respect for other's cultures
Leadership	Tolerance
Sensitivity to impact of science/man on environment/society	Critical awareness of the use of science in the development of biotechnology products
Application of science to society	Respect all forms of life

The above table reflects the attitudes and values that are considered to be important in achieving the national imperatives of social justice, redress and equity. Padilla (1990) supports the notion that values are a set of beliefs and principles of behaviour that govern

scientific research, while attitudes are how we think, feel or interpret things around us. Thus attitudes and values are mutually constitutive and shape each other's development.
Methodologically, the NCS-FET Life Sciences table of cognitive development, table of science process skills and table of attitudes and values could be used to empirically identify the LO engaged in practice, its associated AS and the specific competency being developed. To identify the LO engaged in practice, it becomes necessary to focus on the nature of the activity. For example, does it entail scientific inquiry and problem solving, construction and application of knowledge, or understanding the interrelationship of Life Sciences, technology, the environment and society? By examining the key words outlined in each activity, the AS and the competency to be developed can be identified.

Bloom's taxonomy and Padilla's science process skills are a stage theory of human development and education. In other words, they both have a linear, straightforward view on how humans comprehend information, i.e. in set stages. They do not see the mind as a web. For example, a person might skip from knowledge to application then analyse the application, evaluate it, and then re-analyse the conclusion, while working towards synthesis of information. The post-modern view is that learning is not a linear process that can be classified into hierarchies. Furthermore, Bloom's taxonomy is individualist in that it focuses on how an individual learns. From a behaviourist perspective, learning is seen as a change in observable behaviour. It misses what occurs when there are socio-material forces, e.g. an individual's ability to reach evaluation can easily be clouded by group thinking (Hugo, Bertram, Green, Naidoo, 2008). Bloom's work is located mostly within the tradition of instructional and content specification. It is useful to analyse learning needs and develop tests to meet those demands (Hugo *et al*., 2008).

From a philosophical perspective, OBE learning assumes constructivism (Moll, 2002; Malcolm, 1999). Thus OBE in its ontological, epistemological and anthropological nature is underpinned by constructivist principles (Moll, 2002; Malcolm, 1999). On an ontological level constructivism maintains that there is no reality that exists independently of the socio-cultural environment, while on an epistemological level constructivism states that knowledge is constructed by what is known on the basis of experience (Moll, 2002). The constructivist perspective on knowledge construction ties in with the ANT perspective of knowledge construction. Furthermore, the NCS-FET Policy foregrounds the development of high skill, high knowledge application of knowledge to everyday experiences, and aims to develop an

alternative to the rote learning, memorisation and passivity associated with the apartheid curriculum (Young, 2000). In the NCS-FET Life Sciences Policy knowledge is not a given but is socially constructed. Thus the NCS-FET Life Sciences curriculum is not a body of content but outcomes of political struggles over what counts as knowledge (Young, 2000). The implications of the NCS-FET Policy's intention is a movement from a traditional (objectivist and behaviourist) to a constructivist approach. The consequence is a shift in the perspective of learning and instruction that emphasises the social and contextual nature of learning (Moll, 2002; Malcolm, 1999).

According to Jansen (1999), constructivism has many implications for classroom practices. It requires a shift from the traditional instructional approach to teaching to a constructivist approach, and a change from a teacher-centred classroom to a learner-centred classroom. Teachers as envisaged by policy have lost ground in terms of symbolic space, control and authority (Moll, 2002). Within a constructivist perspective teachers and their pedagogy have been displaced, since teachers are now facilitators with teaching and content displaced by competencies (Jansen, 2000).

Two different frameworks were used to clarify the competencies for the LOs. Closer examination of these two frameworks reveals there are overlaps in the competencies that Padilla (1990) regards as science process skills and Bloom's revised taxonomy of cognitive development. These overlaps have resulted in some competencies being considered as associated with LO1 and LO2, and indicate that these common competencies are valued both in scientific method and inquiry and in knowledge construction - and are thus highly desirable to develop in learners. The relationship between knowledge and skill is not static, it is dynamic and relational. Knowledge is used to develop skill - and as the skill is developed, the knowledge increases.

I argue that the competencies associated with each LO cannot be isolated completely into neat or clearly demarcated categories, and are mutually constitutive. I base this argument on the differing perspectives among scholars on how SKAV can be defined or differentiated. Latour (1989) defines knowledge as familiarity with events, places, people and things seen many times over. This means that knowledge cannot be defined without understanding what gaining knowledge means; knowledge is not something that can be described by itself, but only by considering the whole cycle (network) of accumulation (associations). Esland (2000)

concurs with Latour (1989), and maintains that knowledge is typically obtained from teaching, lectures, reading and observing, while skills are attained through practice by applying the teaching, reading or observation to homework, class exercises and investigative work.

Law (1992) supports both Latour (1989) and Esland (2000), as he sees knowledge as embodied in a variety of material forms as the end product of a lot of hard work in which heterogeneous elements such as microscopes, books, slides, and skilled hands come together to be converted or translated into knowledge. Therefore SKAV development is not about just knowing something but also about practice within a given set of relationships. Hence SKAV development and practice are characterised by dynamism and unique interdependence. I will focus firstly on the interconnectedness of SKAV development and secondly on the link between SKAV development and practice.

Schreuder and Theron (1997, p. 77) refer to skills as "the ability to use one's knowledge effectively and readily in the execution or performance of a task" and knowledge to be "the sum of what is known, i.e. the body of truth, information, and principles acquired by man". This means that knowledge is what is learned and skill is the ability to use the learned information. This definition of knowledge and skill implies that interdependence exists between competencies considered to be skills and knowledge.

The idea that knowledge and skills are linked is supported by Hall, Poliah and Sishi (DoE, 2006). They consider knowledge to be what you know and skills as what you do with what you know. In other words, the concepts of skill and knowledge are relational as they shape the development of each other. The following example illustrates the interwoven nature of knowledge and skill. Driving a car requires both knowledge and skill; the knowledge would be understanding the theory behind operating a car, such as how the car is turned on, where the brakes are located or what to do when the traffic light turns green, and the skills are having the ability to use and apply the knowledge.

Jogensen and Ryan (2004) maintain that knowledge and skills can be distinguished by examining the parts of speech used. If a competency of the curriculum is described with a noun then it is knowledge, if it is described with a verb then it is a skill. For example, 'identify' involves acquiring knowledge, while 'identification' involves the skill of using

knowledge effectively. From Jogensen and Ryan's (2004) differentiation of knowledge and skills it is obvious that they involve certain similar competencies, e.g. identify/ identification, organise/organisation, evaluate/evaluation.

A closer look at the definitions of values and attitudes clarifies that our values are invariably linked and associated with and shape our attitudes towards, for example, work or examinations. Values are defined by Jogensen and Ryan (2004, p. 223) as "internalized sets of beliefs or principles of behaviour held by individuals or groups", while Simpson (1972) regards values as what we hold important and which priorities we set. Halstead and Taylor (2000, p. 2) define values as "the principles and fundamental convictions which act as general guides to behaviour, the standards by which particular actions are judged as good or desirable". From the above three definitions of values, a deduction can be made that our values are linked to our knowledge as it relates to fundamental principles we consider to be important.

Since knowledge is interconnected to both values and skills, values are invariably linked to our skills. Seah (2002, p. 43) asserts that "values represent an individual's internalization, cognition, decontextualization of affective constructs in his/her socio-cultural context, thus values related to science education are inculcated through the nature of science and the individual's experiences in the science classroom". Seah's reference to the nature of science in the definition of values alerts us to the skills and knowledge that form the basis of the science lesson.

Attitude is considered by SCANS (1991) as how you approach things. Since attitude is related to how you approach things and one's approach to something is shaped by one's knowledge, skills and values, attitude is linked to skills, knowledge and values. The following definitions of attitude also make explicit the link between attitude, values, knowledge and skills. Attitude is considered by Harrow (2001) as the way we think, feel and do, while Simpson (1972) maintains that attitude is a way of looking at things.

From the above discussion, an inference can be made that SKAV competencies are not discrete or separate in that they should be considered independently of each other; they are mutually supporting, interrelated and interdependent, as they reinforce one another. It has become a matter of general agreement nowadays that scientific knowledge alone cannot

influence people's employability or human resources development. An equally important partner is the development of skills, values and attitudes, which ultimately influence human resources development and overcoming the skills shortage in South Africa. While the NCS-FET Life Sciences Policy associates certain competences with a particular LO, it promotes the integration of teaching and learning. The implications are that these competences cannot be taught or learnt in an isolated or compartmentalised way. This means that LO1 competencies should not be taught only when learners engage in scientific investigations; they can be taught during LO2, which focuses on knowledge construction. Thus compartmentalised competencies may become of limited use.

The NCS-FET Life Sciences Policy has constructed a particular image for the kind of learner and teacher that emerges at the end of the FET band, i.e. a learner who is able to think on his/her feet when confronted with an unfamiliar situation, and a teacher who is competent, a mediator of learning, a scholar and subject specialist who is dedicated and caring. The NCS-FET Life Sciences Policy sets out the emergent SKAV for learners and teachers. This means that the Policy invariably links SKAV development to the learners' and teachers' classroom practice. According to Hathout (1983), practice refers to the application of rules and knowledge that leads to alterations in our action. In other words, implementation of the emergent SKAV from policy (rules and knowledge) should lead to a change in teachers' classroom practice (action). From Hathout's perspective, practice is an art that is linked to the changing requirements and progress of knowledge, skills, attitudes and values.

This means that SKAV development is occurring at two levels: at the level of learners via the lessons they will receive, and at the level of teachers via the professional development they receive during mediation of policy and the relevant changes they make in respect of their classroom practice. In other words, the professional development teachers receive is meant to be a SKAV developmental process whereby teachers will come to implement changes in their own practice.

2.2.2.7 Conclusion

The literature cited above supports the theoretical argument that action is not the performance of a single actor - action is dislocated and depends on agency granted to the actors. The literature confirms that there are uncertainties and controversies that need to be disentangled

to achieve curricula goals. It indicates that curriculum reform does not involve a smooth transition from one medium to another, but is riddled with tension and controversies that need to be resolved.

The literature reviewed alludes to a relational epistemology that is required for SKAV development if education is to be used for human resource development. The implication of this is that closer ties and networks need to be fostered among the actors at each node during curricula reform. A relational perspective on development shows that our actors' actions can no longer be confined to one node, but are distributed and interspersed in a network. Our actors' actions have a ripple effect on how education can be used for human resource development.

In the next chapter I illuminate the research design used to trace networks of practice with regard to SKAV across the DoE, schools and industry node. At each node I indicate how the trajectory of the NCS-FET Life Sciences Policy document is trailed.

CHAPTER THREE

MAPPING THE METHODOLOGY

"It is no longer enough to limit actors to the role of informers. You have to grant them back the ability to make up their own theories of what the social is made of."
Latour, (2005, p. 11)

3.1 Introduction

This chapter demonstrates how to use ANT as a methodology. According to Stalder (1997), the ANT methodology aims to map association(s) that actors form when they traverse a network. To map associations we follow the actors (Van House, 2001). As mentioned in Part A of Chapter Two, ANT was used both as a theoretical framework and methodology in this study. As a theoretical framework ANT has methodological implications:

- the tracing of policy construction and SKAV development was construed as a networked activity with shifting ties or associations among the actors across the three nodes of the study;
- the role of the enquirer was redefined; and
- the analysis involved picking up and assemblage of the trails at a nodal level and (re)assemblage at a cross-nodal level.

At a methodological level an ANT study involves following actors and picking up their trails, while at an analytical level it is characterised by the assemblage and (re)assemblage of networks. A challenge for the ANT methodology is how to trace networks and shifting ties or associations among actors. As mentioned earlier in Part A of

Chapter Two, ANT's unique vocabulary proposes a relational way of understanding processes and networks as they unfold. In dealing with the challenge of tracing shifting ties, I found the metaphor of a network was important as it revealed the interconnectedness among actors and among the nodes. When the NCS-FET Life Sciences Policy of SKAV development traversed across the different nodes, it formed associations with actors. It was these associations that signalled the trajectories that needed to be traced.

To follow actors, we trace what they say and do in order to establish which other actors are enrolled into the network by them (Latour, 2005). Following the actors allowed me to see how associations are enabled or constrained from the perspective of the actor. In ANT methodology the enquirer does not impose on the actors an *a priori* definition of their world (Latour, 2005). Actors construct their own ontology of what makes up their social world and its impact on their practice. Therefore, according to Latour (2005), an ANT report (thesis) is a description of the translations and transformations brought about by the actors in the networks traced.

This chapter is organised into four sections. I adhered to the suggestion made by Latour (2005, p. 133) that we keep track of all our moves "as everything is data" in section 3.2. The conspicuous actors' practice to be trailed at each node is discussed in section 3.3. While following actors we were mindful of the objectfullness (Latour (2005, p. 33, refers to threats to validity of research as "objectfullness" of the data constituted). of the data, which is elaborated on in section 3.4. The research design to follow actors is explicated in section 3.5, whilst the design for analysis of data is uncovered in section 3.6. The chapter ends with a conclusion.

3.2 Mapping the writing of an ANT report

According to Latour (2005), an ANT report is a description of the translations and transformations brought about by the actors in the networks traced. This means the report is a description of a set of relations defined by translation (Latour, 2005). It is through

these descriptions that "the social is performed" (Latour, 2005). Latour (2005, p. 133) suggests that we keep track of all our moves, even those that involve the writing of this report, because "everything is data, even those that deal with the production of the report". This is not for epistemic reasons, but because everything is considered to be data (Latour, 2005). He suggests that four notebooks be maintained for the following purposes:

- to serve as a log of the enquiry in terms of due dates, time frames, appointments, etc.;
- to record data findings;
- to record data analysis while still doing field work; and
- to map the social from the network traced (Latour, 2005, p. 133).

In this study these records were maintained electronically. A file was opened for the enquirer with three subfiles attached to the main file. The first attached file was entitled 'Dates'. The Dates file served as an electronic diary for my appointments with my supervisor, date of Faculty Higher Degree presentation (defence of my PhD proposal to a panel of experts in the field from the Faculty of Education at the University of KwaZulu-Natal (UKZN), due dates in respect of ethical clearance and data collection at the DoE and schools node, dates for site visits, dates for time frames of the study, dates for PhD students' cohort meetings, and due dates for abstracts of papers.

The second attached file was entitled 'Correspondence'. This contained all correspondence sent and received in respect of the study, namely emails sent to scholars in this field (Mouton[12], Benswick[13]and Mensha[14]), data sent to actors for member checks and their correspondence. The third attached file was entitled 'Mapping the Social' and

[12] Mouton: is a professor at the University of Western Cape in South Africa. I requested information from him on school-industry links in South Africa

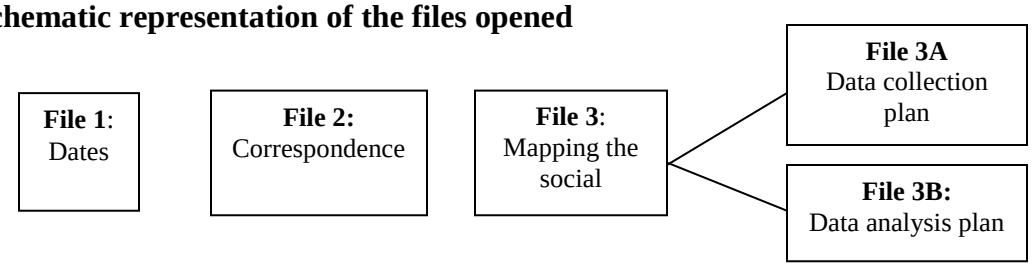
[13] Benswick: is the head of the VET programme in Australia. I requested information from him on the VET programme conducted at Glossop High.

[14] Mensha: is a professor from Ghana who initiated the STAG programme in Ghana and contextualised the school science curriculum with the help of industrialists.

contained two subfiles: one pertaining to data collection and the other to data analysis. A manual journal came into being at the schools node during the delivery of questionnaires. This was originally not part of my research design strategy. It came into existence incidentally after delivery of the first questionnaire, since I was overwhelmed with information about the "occurrences" in the Phoenix North region. These three electronic files and the journal from the schools node were maintained, since everything in an ANT study is considered as data.

The schematic representation below illustrates what the files maintained looked like.

Schematic representation of the files opened



File 3A: Table for data constitution

Node	Practice followed	Conspicuous actors followed	Instruments used to collect data
1. DoE	Mediation of policy	Subject advisors	Observation of mediation of policy
2. Schools	Implementation of policy	Life Sciences teachers	Questionnaire, observation of lesson, post-observation focus group interview, journal entries
3. Industry	Mediation of workplace learning	Education officer, mentors, NTEW	Observation of mediation of workplace, semi-structured interview, conversations

Data were analysed to answer the two research questions posed by this study: *How is policy constructed and translated in practice as it circulates across the DoE, schools and industry nodes? Is there an interface in terms of policy construction and SKAV development across the nodes - and if so, what is the nature of the interface?* Analysis entailed assemblage at a nodal level and (re)assemblage at a cross-nodal level.

File 3B: Table for data analysis

Assemblage (DoE, schools, industry node)	**(Re)assemblage (cross-nodal level)**
Data collected at each node were transcribed	Assembled networks were placed side by side
The data were read several times to identify key terms and actors enrolled into the network	The networks were examined for points of convergences in respect of policy construction and SKAV constitution to see if there was an interface
Patterns of meanings were established	Since an interface existed, I noted all f(actors) that altered the optical density of each node from the nodal networks
Patterns of meanings that were similar were grouped together	The alliance network formed at each node was inspected to explore if they remained stable, evolved or restructured themselves, and if they traverse and infiltrate the other nodes
Reread patterns of meanings to ensure similar patterns were weaved together	I noted how the alliance networks were responsible for the refraction at the point of interface in order to describe the nature of the interface
Categories formed for construction of policy	
Associations formed in each construction of policy were noted for convergences or divergences	
The impact of the associations were noted	
Response of the conspicuous actor to the networked actor was noted to establish how practice gets performed	
During practice the activity engaged in is identified to identify the LO	
Note keywords used in activity to establish the SKAV constituted in practice	

These files will be closed upon completion of this study. In order to map the social I needed to trail the practices engaged at each node, which are brought to the fore in the section below.

3.3 Practice(s) to be trailed at each node

In this study the practices trailed at the DoE, schools and industry nodes are mediation of policy, implementation of policy and mediation of workplace learning respectively. Haraway (1988) maintains that the practice engaged in at each node entails learning. She argues that the learning arises out of a web of interactions at a particular location; in a particular practice and all elements participate in the achievement of "learning". The view that learning is situated in practice is supported by Pickering (1987), who maintains that practice involves interaction with materials that play a constitutive role in knowledge production and learning. In this regard, Rouse (1996) stresses that practices are not just patterns of action but the meaningful configuration of the world within which action occurs. This means that practice incorporates the materials that they are enacted with and the setting in which they are enacted. Therefore, the practices of mediation of policy, implementation of policy and mediation of workplace learning are under the spotlight during analysis. The nodes in this study become obligatory passage points in the network of SKAV development which an actor must pass through to maintain this network.

3.3.1 DoE node

The DoE node is involved in the mediation of policy - intervention offered by actors to bring about enrolment, enactment and translation in networks (Latour, 2005). In South Africa, mediation of policy is the professional development offered by the DoE to practicing teachers to implement new policies. It is thus, a mechanism to facilitate diffusion of curriculum policy change from its formulation to its implementation, and is conducted by subject advisors who are DoE employees. All Life Sciences subject advisors have a tertiary qualification in biology. The subject advisors would, at some stage in their career, have engaged in the teaching of biology. They are thus supposed to

be *au fait* with innovative teaching methods and conscious of the dynamics within which teaching occurs.

The appointment of subject advisors could be based on their political alliances or on affirmative action[15], or what is construed as best practice by the DoE, i.e. consistently obtaining a 100% pass rate in the National Senior Certificate exam. Subject advisors provide professional development and support for practicing teachers in their respective regions during policy reform and curriculum implementation. They monitor the implementation of curricula by teachers and are also responsible for the moderation of teachers' continuous assessment (CASS)[16] portfolios. They are thus considered to be at the coalface of policy negotiation and curriculum delivery (Naidoo, 2007). In addition, they are involved in appointment of National Senior Certificate exam markers, and may serve on the provincial and national curriculum development panel.

During mediation the subject advisors network and enroll other actors to facilitate mediation. In this regard, mediation of policy is construed as an educational helping relationship to accomplish the intended goals of policy. Therefore, mediation forms the vital link between policy formulation and policy implementation.

3.3.2 Schools node

At the schools node Life Sciences teachers are involved in implementation of the NCS-FET Life Sciences Policy. This involves enrolling learners with the curricula content of the policy, monitoring learners' progress in respect of SKAV development, engaging learners in extra- and co-curricular activities associated with their particular schools, maintaining tone and discipline, and providing moral, emotional and social support to

[15] Affirmative action: preference is given to African individuals to bring about equity, and redress in employment

[16] CASS portfolios: A teacher's file which contains records of the work schedule for assessment, assessments given to learners, analysis for the assessment given and a mark schedule

their learner. They may be expected to teach other learning areas, depending on their school's post-provisioning norm (PPN)[17]

These Life Sciences teachers were previously known as biology teachers. All the Life Sciences teachers in the Phoenix North region have a tertiary qualification in biology. They engaged in the teaching of biology prior to implementation of the NCS-FET Life Sciences Policy in schools in 2006.

3.3.3 Industry node

The industry node of this study engages in the practice of mediation of workplace learning, which is an in-house programme designed by the Chief Education Officer of this industry to enroll their NTEW with the SKAV needed for them to function effectively in their jobs. The NTEW enters the world of work directly after completing schooling, and hence has no tertiary qualification. NTEW in this industry work alongside tertiary-qualified personnel and engage in the same SKAV - but do not earn the same salary as their colleagues with tertiary qualifications. In-house training entails practical on-the-job training and a formal component, i.e. an examination, set by an external evaluator of the workplace learning programme.

The Chief Education Officer has a Magister pharmacy degree and is currently reading towards a PhD. She is a shareholder in this industry who is responsible for: designing the workplace learning programme, and the SKAV that need to be enrolled in the NTEW for them to function effectively in their jobs, recruitment of employees, and internal evaluation of the NTEW enrolment of SKAV. The Chief Education Officer is assisted with the monitoring of the workplace learning programme by three mentors (qualified pharmacists) who are responsible for mediation of workplace learning. They do not

[17] PPN: Post-provisioning norm is determined by the provincial DoE. The PPN refers to the number of teachers a school is entitled to. The PPN value is determined by the learner population and subject sets of a school.

engage in the design of workplace learning. They are accountable to the Chief Education Officer.

The NTEW were involved in the application of biotechnology in this industry, and a prerequisite for their employment in this industry was having biology (now Life Sciences) as a school subject. The NTEW in this study were purposively selected. They had schooled in the Phoenix North region, and forged a link between the schools and industry node in respect of the network of SKAV development. The NTEW received mentoring from the education officer and mentors during mediation of workplace learning to engage in the application of biotechnology in this industry.

While tracing the conspicuous actors' practice(s) outlined above, I needed to be attentive to the theoretical implications of using ANT as a methodology. As noted earlier (in section 3.1), the methodological implication is that the role of the enquirer is redefined in an ANT study. In an ANT study the role of the enquirer contributes to the objectfullness of the data constituted (elaborated on in the next section).

3.4 Mapping the "objectfullness" of data constituted

Like other qualitative studies, ANT studies are also concerned with issues of validity. Latour (2005, p. 33) refers to threats to validity of research as "objectfullness" of the data constituted. From an ANT perspective data constitution allows for socio-material elements to be trailed by the enquirer. Latour suggests that the role of the enquirer in an ANT study is vital in ensuring the "objectfullness" of the data constituted (Latour, 2005). The enquirer's role is to follow the actors, assemble the trails created by the actors and to be "one reflexive loop behind the actors" (Latour, 2005, p. 33). By following the actors and picking up the trails left by an actor, the enquirer is obliged to record everything without being selective about which trails to pick up. The enquirer therefore does not impose order by limiting the range of "acceptable accounts" provided by the actors. All accounts provided by the actors are assembled. In this way, the enquirer in an ANT study is exculpated from subjective selection and tracing of data.

The enquirer is required to pay attention to what actors say or do in order to provide a full description of events as they occur, without adding his or her own interpretation of the actors' accounts (Latour, 2005). Latour reminds the enquirer not to forget that it is his or her duty "not to decide how actors should be made to act, but rather to retrace the many different worlds actors are elaborating" (Latour, 2005, p.49). Hence, in an ANT study all the actors' voices take precedence over the enquirer's voice, and actors develop their own ontology of their practice and what constitutes their social world (Latour, 2005). This means that in an ANT study the lived experiences of the actors take precedence.

Now that I am attentive to how to maintain objectfullness in an ANT study during the constitution of data, the next section outlines the research design of this study.

3.5 Mapping the research design of the study

Data are constituted at three nodes, DoE, schools and industry. As noted earlier, data constitution is multi-sited to trace the trajectory of policy, construction of policy and constitution of SKAV. The multi-sited trailing of policy in practice will allow the emergent effect of policy to come to the fore. The research design is organised to focus on the issues of gaining access pertaining to each node, location of each node, sampling, overview of the actors, how data are captured and steps taken during analysis of data.

3.5.1 Mapping gaining of access

Gaining access to each node of the study meant dealing with various gatekeepers, for example KwaZulu-Natal DoE, Life Sciences subject advisors, and mentors. According to Neuman (2000, p. 52), a gatekeeper is "someone with formal and informal authority to control access to a site". Formal or official permission is when the gatekeepers in a given set-up grant permission to conduct research in a particular organisation. Informal or social permission occurs when participants accord the researcher the necessary rapport to allow the investigation to proceed smoothly.

For the DoE and schools nodes, written permission was sought and obtained from the KwaZulu-Natal (KZN) DoE to conduct this study in the Phoenix North region (see Appendix A, Annexure A3, p. 143 for letter of permission to conduct research). Permission was also obtained from the subject advisor to observe mediation of the NCS-FET Life Sciences Policy document. Mediation of policy was observed for its full duration, i.e. 4.5 days. The Phoenix North region was purposively selected as it has schools in its jurisdiction that belonged to previous ex-departments of education, namely the House of Delegates (ex-HoD, which controlled Indian education prior to democracy), the House of Assembly (ex-HoA, which controlled White education), and the Department of Education and Training (ex-DET, which controlled African education). A few independent schools within the region attend meetings at the Phoenix District Office and subscribe to the KwaZulu-Natal Provincial Department's teaching and assessment requirements. The schools in the Phoenix North region have diverse infrastructures and resources, but all obtain a pass rate above the national norm of 78% (Moonsamy, 2008).

School principals and Life Sciences teachers were consulted to observe implementation of policy at schools. Principals gave me access to their schools and the Life Sciences teachers were willing to participate in this study. Teachers were purposively selected and had to be engaged with implementation of the NCS-FET Life Sciences Policy.

At the outset I declare having a close working relationship with the Life Sciences teachers in the Phoenix North region spanning over 20 years. My interaction with the teachers was multi-layered: they engaged with me as a moderator of their Grade 12 CASS portfolio and as a regional examiner and moderator for Biology, Physical Science and Life Sciences papers. Many of the Life Sciences teachers in this region participated in my Masters study. I have always enjoyed a supportive relationship with my Life Science colleagues. I also declare that I am known to the Phoenix North schools' management and the Superintendent of Education Management. While declaring my position, it is crucial to remember that the role of the enquirer in this study is guided by the theoretical framework, ANT.

To conduct teacher observations at a prestigious independent school proved to be an unusual experience for someone from the State schools. The Life Sciences teacher, Meg (pseudonym), who regularly attends meetings at the Phoenix District Office, allowed me access to her Grade 11 and Grade 12 Life Sciences lessons. She was keen to be a part of the study. Meg was mentored by me when she was a student teacher. She also volunteered to make arrangements for me to observe her Life Sciences colleague RB's Grade 10 Life Sciences lesson. RB is also the head of department at Meg's school.

When approached, RB advised Meg that my observing their lessons was "not a good idea"; she felt it could have serious implications for their school with regard to how the curriculum is enacted and implemented. It would allow an outsider to know what goes on in their lessons and to have access to their teaching records. She did not want their school to be in the "spotlight". Neither did RB want the DoE to get a glimpse of their enactment of the curriculum through this study. RB also reminded Meg that they have very high-profile students (children of Ministers of Parliament) at their school - my observations of their lessons could have safety implications for their learners. Meg apologised profusely for not being able to carry out her initial promise, and indicated that she had to abide by RB's decision since RB was her superior. She also explained that it was RB who had secured her a job at this independent school. I informed Meg that I respected their decision, and enquired whether I could use this personal communication between us as data. Meg supported this decision.

Gaining access to industry for the main study posed a problem. Five of the six industries that participated in the preliminary study did not want to participate in the second stage of the research. These five industries indicated that they were concerned with issues of equity in respect of race and gender raised in question 7 of the preliminary study questionnaire (see Appendix B, Annexure B8, p. 175). They were concerned about the potential impact of the findings of this research on their company's reputation.

A pharmaceutical site in the North Durban region was the only industry willing to participate in the second stage of the research. This industry was used as a generative example to understand how policy is constructed and which SKAV are constituted during mediation of workplace learning in NTEW. This company was started by two brothers who see their company as an agent of social change. They offer opportunities to NTEW to get a South African Qualifications Authority (SAQA)-recognised qualification. The brothers share a common vision - to revolutionise the pharmaceutical world by providing affordable and accessible healthcare services. They also wanted to offer healthcare counselling and support to their clients at their retail pharmacies. It was their vision to establish a disease management centre where their clients could be assisted in improving compliance and be given private counselling and advice.

An important lesson of this study is that access is an iterative process and not a once-only decision. Negotiating my way past the gatekeepers was only the start of a long process of access to people and information which was to last throughout the study. Upon reflection, access is seen as a deeper process of building relationships during data constitution.

At the industry node I was confronted with an ethical and moral dilemma. As a methodological deployment, I had originally thought of seeking employment with the pharmaceutical industry. This was to engage in covert research in order to follow and observe the NTEW with regard to enactment, performance and enrolment of SKAV. Under the guise of a “worker” in the pharmaceutical industry, I would not write about how my skills were being shaped, but the experience would allow me to see how “other workers” have their skills shaped, reproduced and translated. My presence as a “worker” was for methodological deployment and purposes and not to use the experience for analytical purposes. The pharmaceutical industry had given me permission to embark on covert research. While an embedded way of obtaining data was considered initially, moral and ethical dilemmas concerning covert research preoccupied me.

To deal with the situation, I drew on the work of scholars such as Henning, Van Rensburg and Smith (2004), Bulmer (1980), De Vos, Strydom, Fouche and Delport

(2005) and Cohen and Manion (2002). I pondered on the theoretical underpinning of this study. These scholars argue that researchers have a moral obligation to respect and protect those involved in or affected by their research. They explain that ethical concerns in educational research are often complex and subtle, and can sometimes place the researcher in a moral predicament that may be difficult to resolve. The study was informed by what these scholars refer to as the "moral responsibility" of a qualitative researcher. They advise a researcher to build rapport with participants on the basis of trust and free and open communication. I realised that engaging in covert research would negate my moral responsibility as a researcher and challenge the methodological rigor of the study.

Covert research, according to Bulmer (1980), flouts the principle of informed consent. Bulmer (1980) alluded to covert research methods as the theft of data from unsuspecting victims. The actors are construed as naïve individuals. The element of trust would be absent from this type of relationship. I considered trust to be a desirable quality when engaging in research that depends upon any kind of co-operation. I considered damaging or destroying a trustworthy relationship to be a foolish venture. I realised that covert research methods might damage the behaviour or interests of the subjects by drawing attention to what they preferred to remain unnoticed. Whether the effects of research are favourable to its subjects or unfavourable, the implications of publication are such that subjects are entitled to have control (Bulmer, 1980). Covert research methods deprive participants of such control**.**

Had I embarked on covert research, I would have brought the issue of morality and power dynamics between the participants and the enquirer to the fore. ANT opposes the assumption that the enquirer is dealing with naïve actors who need emancipation (Latour, 2005). As the ethical dilemma continued to perplex me, I was confronted with the following questions: Was I the "outsider" trying to be an "insider" by invading their space and lives, gaining information that would benefit me? Would they see me as a spy employed by management or as someone who could create an awareness of the need to prepare learners for the world of work? If I embarked on covert research at the industry

node of the study the rapport with research participants would be built under false pretences. Such tacit mistrust could not elicit open and free communication (Henning, Van Rensburg & Smith, 2004). The moral and ethical dilemmas that confronted me led me to decide not to embark on covert research at the industry node of the study. I informed the human resources personnel of my decision, and subsequently requested permission to conduct research within the pharmaceutical industry.

3.5.2 Mapping how data are constituted

Methodologically I draw on ANT's conceptualisation of a network to constitute data at each node. As mentioned previously (in Part A of Chapter Two), networks are construed as consisting of actors that are connected together by associations. Data are constituted by tracing the trails created by the conspicuous actor involved in practice at each node. To follow the conspicuous actor is to unveil the actor's action (Latour, 2005). As noted earlier, ANT's unique vocabulary is interrelated and cannot be used in an insular manner.

The metaphor of unveiling indicates a process of looking for and discovering a hidden, obfuscated background in relation to all entities making up the network (Latour, 2005). I examined the actions (what they say and do) of the conspicuous actors during their practice in order to observe what or who gets enrolled or networked into the practice of the conspicuous actor (Latour, 2005). I found myself tracing circulating associations and not actors *per se*. As mentioned earlier (Part A of Chapter Two), tracing networks elucidates how socio-material elements participate in practice, and what gets performed through their participation (Mol, 2007). This means (as noted in Part A, Chapter Two) that the tracing will bring to the fore the hidden presence of social aggregates.

The notion of the network allows me to view the ties or associations formed with the networked actors. It is important to examine the associations developed within the network as they dynamically shape and re-shape the characteristics of the actors. In other words, these ties affect actors and translate practice in a complex web of interconnections. A closer examination of the associations or ties during data analysis

will reveal the convergences, divergences, alliances formed or subversions in the network in terms of policy construction and SKAV constitution. During the examination of ties I explored the ways that the network of relations is composed, how they emerge and come into being, how they are maintained, how they compete with other elements, and how they are made durable over time (Latour, 2005). This means that (as discussed in Part A, Chapter Two) the analysis maps the relations among actors. Data are constituted at the level of policy construction and SKAV constitution at each node.

3.5.2.1 DoE node

At the DoE node data are constituted by observation of mediation of policy in order to answer the following research question: *How is policy constructed and which SKAV are constituted in practice at the DoE node*? Mediation of policy was observed for its entire duration, i.e. 4.5 days, in the Phoenix North region. Mediation of policy was held at the Phoenix Teachers' Centre which has conference rooms and conference facilities. The mediation of policy was video recorded from the back of the conference room, covering almost the whole room. Personnel from the Phoenix Teachers' Centre conducted the video recording (as they do on a regular basis), at a predetermined cost. The recording began 10 minutes prior to commencement of the mediation session.

The video recording is a mirror image of the practice of mediation of policy. When viewing the video recording, I looked at the actors networked into the practice of the subject advisor, the associations formed with these actors, the actions of these actors and how these associations shape the practice of the subject advisor. These steps allowed me to constitute data in respect of how practice gets performed and how policy is constructed during practice. For the collation of data in terms of SKAV constitution, I drew on ANT's notion of network. I examined what is done in practice in terms of activities undertaken and associated the activity to a particular LO contained in the gazetted NCS-FET Life Sciences Policy. Methodologically the NCS-FET Life Sciences table of cognitive development, table of science process skills and table of attitudes and values (see Chapter Two for tables) was used to empirically identify the LO engaged in practice,

its associated AS and the specific competency being developed. To identify the LO engaged in practice it is necessary to focus on the nature of the activity: such as, does it entail scientific inquiry and problem solving, construction and application of knowledge or understanding the interrelationship of Life Sciences, technology, the environment and society? By examining the keywords outlined in each activity, the AS and the competency to be developed can be identified.

3.5.2.2 Schools node

At the schools node an open-ended questionnaire, classroom observation and post-observation focus group interview were used to answer the second research question: *How policy is constructed and which SKAV are constituted in the practice of policy implementation* (see Appendix D, Annexure D3, p. 216 for questionnaire). The questionnaire was used to establish, firstly, which teachers in the Phoenix North region were involved in teaching the NCS-FET Life Sciences curriculum, and secondly, which teachers were still engaged in the teaching of module one (pertaining to aspects of biotechnology) of the curriculum. In other words, the questionnaire was used to purposively select teachers for this study; the teachers still engaged in the teaching of module one would become the core from which the sample of teachers for observation would be drawn.

The questionnaire was piloted with 10 Life Sciences colleagues two months prior to data capture to identify and correct any flaws in the questionnaire (Cohen & Manion, 2002). During the piloting session the respondents were presented with the questionnaire and asked to answer the questions. Respondents were reminded that there were no wrong or right answers - only honest answers. After the questionnaire was piloted it was delivered personally to 45 Life Sciences teachers in the Phoenix North region. I believed that delivering the questionnaires personally would enable the participants to know about the study first-hand. A total of 45 questionnaires were collected from the Life Sciences teachers, indicating a return rate of 100%.

During delivery of the questionnaire to the first Life Sciences teacher, I was regaled with anecdotal incidents about the Life Sciences teachers in this region. As mentioned previously, I had a very close working relationship with the Life Sciences teachers in this region and had been away from the region on sabbatical for two years. I was bombarded with information about developments in the region and decided to record the anecdotal incidents in a journal (see Appendix D, Annexure D2, p. 209), thus adhering to Latour's position that "everything is data" (Latour, 2005, p. 133). This was not part of the data constitution strategy originally conceptualised for this node. This journal was maintained during all three stages of data constitution at this node. Writings from this journal are used to corroborate findings during the network tracing activity.

The questionnaire consisted of six questions aimed at seeking the responses of Life Sciences teachers on issues such as FET mediation sessions, SKAV focused upon, the module and section they are currently teaching, factors that constrain or enhance the development of SKAV, and correlation between SKAV developed via the NCS-FET policy and SKAV needed by industries using the application of biotechnology.

The observation of Life Sciences lessons was conducted at four schools in the Phoenix North region. Lessons of Life Sciences teachers engaging with module one, i.e. tissues, cells and molecular structures and aspects of biotechnology, of the NCS-FET Life Sciences Policy were observed. During this stage of data constitution many of the Life Sciences teachers (28) were away on FET courses organised by the KZN DoE. These teachers also teach other learning areas, such as Mathematics Literacy, Economic Management Sciences (EMS), Travel and Tourism and Hospitality Studies. Twelve Life Sciences teachers had already completed modules one and two and could not form part of the sample. They planned to spend more time on their engagement with evolution, a section they had never taught before. Of the remaining Life Sciences teachers, all five volunteered to have their lessons observed via video recordings.

Observations were conducted at the four schools over a period of one week (five days). At one of the four schools, two Life Sciences teachers' lessons were observed. The week

was spent not only observing Life Sciences lessons, but also video recording the teaching and learning ethos of the school in terms of security, cleanliness, physical infrastructure, school fees, and the DoE policy and its impact on the school. In respect of the Life Sciences lessons observed, only one lesson per teacher (of one hour) was video recorded and transcribed.

Data obtained through the questionnaire and observations of lessons were presented to the five Life Sciences teachers during a post-observation focus group interview held at the Phoenix Teachers Centre (which was centrally situated for all five). The focus group interview was video recorded by personnel from the Teachers' Centre from the back of the room. Teachers were requested to comment on the findings in respect of the format of their lessons, assessment, and their reasons for focusing on particular SKAV (see Appendix D, Annexure D7, p. 234).

When observing the video recordings, data were constituted by noting which actors are enrolled by teachers during their practice of implementation of policy. Furthermore, I examined the ties, associations, actions and alliances formed with these networked actors, and the impact of these actors on their practice of teaching. This afforded me the opportunity to ascertain how practice gets performed and how teachers construct policy in their practice.

To establish data on SKAV constituted in practice, I relied on ANT's conceptualisation of a network and how actors are connected together by associations. I examined the activities the teachers engaged learners in during practice. The activity was associated with the LOs contained in the NCS-FET Life Sciences Policy in order to identify which LOs learners were engaged with. I connected to the words used in the activity to identify the ASs and SKAV constituted in practice. To empirically identify these competencies, they were matched with the NCS-FET Life Sciences table of cognitive development, table of science process skills and table of attitudes and values (see Chapter Two for tables).

3.5.2.3 Industry node

At the industry node my intention was to answer the third research question: *How is policy constructed and which SKAV are constituted in practice by industry using the application of biotechnology in the NTEW?* Three data sources were used: the Chief Education Officer, mentors and NTEW. Data were constituted through observation of mediation of workplace learning, semi-structured interviews with the Chief Education Officer and mentors, and informal conversation with NTEW. I was not allowed to video record mediation of workplace learning in the production room due to issues of espionage and company policy.

Observation of mediation of workplace learning was conducted over 10 days using the observation schedule. I encountered a dilemma prior to observation as I was uncertain how to empirically identify the SKAV enrolled during the mediation process. I expressed my dilemma to the human resources personnel and I was networked with the agency that evaluates NTEW performance and the in-house workplace learning programme. The evaluator from the agency was extremely helpful and supplied me with a copy of a schedule of SKAV needed in this industry and the characteristics of the SKAV so that they could be empirically identified (see Appendix E, Annexure E3, p. 238**)**. This schedule is used by this accredited agency to evaluate NTEW and workplace learning, and delineates the thirty three competencies needed in the NTEW into thirteen LO1; seven LO2 and thirteen LO3 competencies. The NTEW are expected to display these thirty three competencies when they are being evaluated. The evaluation is a formal way to ascertain if the NTEW qualify as registered pharmaceutical assistants. Equipped with this structured observation schedule I began observing mediation of workplace learning for six NTEW who schooled in the Phoenix North region.

A semi-structured interview was used to obtain data from the mentors and the Chief Education Officer on SKAV needed by the biotechnology industry in the NTEW (see Appendix E, Annexure E1, p. 235). The interview was audio recorded and transcribed. A

semi-structured interview was used since it allowed the respondents space for self-expression and allowed for probing to provide detailed, elaborate answers to questions on the SKAV required by industries (Denzin & Lincoln, 2005). Putting together the questions for the semi-structured interview was guided by the gaps identified in the literature in respect of: unpreparedness of learners for the world of work (JIPSA, 2007; Fish & Crossland, 1995), the knowledge base needed in prospective NTEW, the basic SKAV required to be present in prospective NTEW, the type of workplace learning programmes available to NTEW for the development of SKAV required in this industry, and support services available for NTEW who are not coping with the WPL programme in place.

Once interview questions were finalised they were piloted with two education officers in the pharmaceutical industry prior to data-capture, to check the clarity of the questions and eliminate ambiguities or difficulties in wording. Informal conversations called "snap-shots" held with NTEW were also audio recorded and transcribed. A snapshot is a replica of the original image or representation (Delphion, 2008). In other words, this was a true representation of the actors' explanations or how they accounted for their actions. The snapshot provides a brief glimpse into an actor's life. In this study the snapshot centred on three issues: who they are, what they did and what they say, in keeping with ANT's theoretical underpinning for tracing the trajectory of an actor.

The data from the semi-structured interview and the snapshots were used to constitute data in respect of policy construction. I paid attention to what the actors said or did about schooling and the policy to note the actors enrolled and the impact of these on the construction of policy. To establish the SKAV constituted during mediation of workplace learning, the observation schedule was used for the six NTEW from the Phoenix North region. The SKAV contained in the observation schedule were connected and associated to the activity undertaken by the NTEW during mediation of workplace learning. This was done in order to identify the SKAV enacted by the NTEW. The observation schedule had three columns to reflect whether the NTEW were competent at enacting the SKAV, needed more practice (could enact the SKAV but not with confidence), or needed help

(they could not enact the SKAV). During the observation of mediation of workplace learning a cross was placed in the relevant column for each of the 33 SKAV for the six NTEW observed. A separate observation schedule was used for each NTEW. Photographs were taken of the enactment and enrolment of SKAV during the observation period.

The data collated needed to be assembled, which is described in the next section.

3.6 Mapping the design for analysis

The analysis involves assemblage of traced networks at a nodal level and (re)assemblage at a cross-nodal level. The analysis process was guided by the ANT framework. From an ANT perspective, practice is construed as the assemblage of socio-material actors in a location (Latour, 2005). Analysis therefore, involved assemblage of the trails traced.

All data sets collected at each node were transcribed. Video transcriptions noted the setting in which the practice occurred, the learning materials in the room (e.g. charts, other materials not defined as learning material but crucial for the constitution of SKAV development), other actors networked into practice, and how these actors impacted on the practice observed. This provided an empirical basis for discussing the materials woven into practice.

Transcriptions pertaining to each node were read several times to identify key terms and establish patterns of meanings. My reading was guided by the ANT framework, which requests the enquirer to focus on what actors say and do in practice in order to open up, defragment and inspect what was said and done to allow actors to develop and construct their reality of what constitutes their practice (Latour, 2005). In this regard, Law (2009, p. 2) maintains “in teaching telling is doing”. Words, according to Law (2009) are performative, they don’t just describe, in describing they also denote action. This means, that the description help to bring what words are describing into being. In each practice observed there was an actor who is supposedly conspicuous as being responsible for the

practice - for example, subject advisors are responsible for mediation of policy, and Life Sciences teachers are responsible for the implementation of policy. All trails created by the conspicuous actors were woven together by repeated reading and inspection of the transcripts. Patterns with similar meanings were grouped together to form categories for policy construction. Thus, the construction of policy arises from or out of the assemblage of socio-material actors.

By tracing what the conspicuous actor said or did I was able to identify and note all the other inconspicuous "supporting" actors that were networked and recruited into their practice (Latour, 2005). As mentioned earlier (Part A of Chapter Two), the analysis shows the unsuspecting, behind the scene actors involved in practice. This means that the focus was on actors, networks and associations. Each construction of policy illuminates the alliance formed by the conspicuous actor with actors networked, deployed and recruited during the specific practice. In other words, the relationships and associations that I referred to in Part A of Chapter Two are now construed as alliances in this study. The alliances formed make visible the displacements, tensions, unstable relations and group formation within the network. Therefore, the alliances formed lead to either convergence or divergences in the network during practice.

The ties between and among the networked actors and the conspicuous actor provided signals to trace how the latter responds to the effect of the networked actors on their practice. I invoked the metaphor of optical density (see Chapter One) to elucidate how the alliances formed alter the composition of the nodes and how practice gets performed. What gets performed in practice illuminates the SKAV constituted in practice. To empirically identify SKAV constituted at the DoE and schools nodes, strict attention was paid to the nature of the activity engaged in. This led to identification of the corresponding LO. Once the LO was identified, attention was paid to what was said or done to identify the SKAV concerned. The identified SKAV were placed alongside the NCS-FET Life Sciences Policy classification of SKAV to confirm the SKAV that were constituted (see Chapter Two for further discussion on SKAV). To empirically identify

SKAV constituted during mediation of workplace learning at the industry node, the list of identifying characteristics of SKAV provided by the evaluation agency was used.

At the cross-nodal level, data collated at the DoE, schools and industry nodes were (re)assembled. During the (re)assemblage, data from the assemblage stage were juxtaposed to answer the second research question. I examined the networks to note points of convergence in respect of policy construction and SKAV constitution. This was necessary to establish if an interface came into being in terms of policy construction and SKAV constitution. Since an interface existed, I needed to describe the nature of the interface. I noted all the f(actors) that altered the optical density of each node from the nodal networks. The alliance network formed at each node was inspected to explore if they remained stable, evolved and/or restructured themselves, and if they traversed and infiltrated the other nodes. I noted how the alliance networks were responsible for the refraction at the point of interface in order to describe the nature of the interface.

3.7 Conclusion

In this chapter the methodological challenge of tracing shifting ties among actors was raised. This particular challenge was resolved by drawing on ANT's conceptualisation of a network. In ANT the notion of a network highlights the interconnectedness among the actors and nodes of the study (Latour, 2005). As policy traverses the different nodes, it forms associations with subject advisors, teachers, stakeholders, industry, NTEW, etc. In these associations actors are constantly redefined or reshaped. The redefining or reshaping that the actors encounter is considered by Latour (2005, p.25) as translation. It is the translations that are traced by the enquirer. During the tracing of translations the enquirer pays strict attention to what an actor says or does. This allows the actors to map the social in the accounts they provide. This means, that actors create the contextual reality of their practice in what they say or do. Thus, the role of the enquirer in an ANT study is redefined. The enquirer is "one reflexive loop behind the actor" (Latour, 2005, p. 33).

While Chapter Three demonstrated how to trace the trails left by an actor, Chapter Four entails the assemblage of the trails. The notion of an actor network comes into being in this chapter.

CHAPTER FOUR

MAPPING THE SOCIAL CONTEXT

"Actors are always engaged in the business of mapping the 'social context' in which they are placed … This is why it is so important not to define in advance what sort of social aggregates could provide the context for all these maps. Group delineation is not only one of the occupations of social scientists, but also the very constant task of the actors themselves. Actors do the sociology for the sociologists and sociologists learn from the actors what makes up their set of associations." Latour (2005), p. 32

4.1 Introduction

The aim of this chapter is to present findings that answer the first research question of the study, viz. *How is the NCS-FET Life Sciences Policy constructed and translated in practice as it circulates across the DoE, schools and industry nodes?* The first research question is broken down into three subquestions pertaining to the type of practice occurring at each node:

- *How is policy constructed and which SKAV are constituted in practice at the DoE node?*
- *How is policy constructed and which SKAV are constituted in practice at the schools node?*
- *How is policy constructed and which SKAV are constituted in practice by industry using the application of biotechnology in the NTEW?*

In Chapter Three I traced the network(s) created by the conspicuous actor responsible for practice at each of the three nodes, while in this chapter I analyse the traces at a nodal level. The analysis involves the assemblage of heterogeneous elements to establish how

they alter the optical density (composition) of each node in this study. The optical density of each node determines the degree of refraction (translation) that occurs at the point of interface when the NCS-FET Life Sciences Policy traverses from one node to the next.

In this chapter I assemble the networks that were created by the conspicuous actors in the three nodes of the study. A functional sketch of the actors enrolled into the network was made for each node (see Figures II, III and IV in this chapter). The sketch reflects the bits and pieces that are connected in the network. The sketch was created to re-enact the multiplicity of actors participating in practice. In creating the sketch it was important to note the number of ties an actor has with other actors. Noting the number of ties an actor has shows how embedded these actors are in the practices observed. Therefore, in the analysis the associations of actors are examined for their contribution to the structure and stability of the network created.

There are four sections in this chapter. The first three attempt to answer the three subquestions of the first research question, centring on the construction of policy and constitution of SKAV in practice. The final section concludes the chapter by bringing to the fore the socio-material context, reality or ontology of the nodal networks.

4.2 Mapping the presentation of findings

Each construction of policy illuminates the alliance formed by the conspicuous actor with actors networked, deployed and recruited during the specific practice. The alliances formed are relations that I referred to earlier (Part A, Chapter Two, p. 26). The alliances formed are collaborations among the actors, they reflect the kinds of work the actors are doing in the practices observed. These alliances are either complementary or contradictory, and they can lead to either affirmation or subversion of policy. Alliances therefore lead to either convergence or divergence in the network during practice. This means that the NCS-FET Life Sciences Policy is affirmed or subverted in different ways within each construction of policy, depending on the actors enrolled.

The alliances formed are thus fluid; they have the ability to shift and (re)associate with other actors, thereby aligning more actors into the network (Latour, 2005). The fluidity of the alliances also brings to the fore the unstable relations, uncertainties and continual displacements that actors encounter within the network. These (re)alliances and (re)associations shift in response to the interest of the conspicuous actor in facilitating the practice. The alliance formed unearths the strategies used by the conspicuous actor to enroll actors for specific practices. Therefore, alliances elucidate how the optical density of the node changes, how practice gets performed, which SKAV are constituted in practice and how the socio-material reality or social context emerges via the network created. This socio-material reality is the reality that is created by the actors. It is the ontology of the network.

4.2.1 DoE node

At the DoE node I present the findings to answer the question: *How is policy constructed and which SKAV are constituted in practice at the DoE node?*

In presenting the findings it is worth noting that the analysis reveals that during mediation of policy, many actors not conventionally considered as being associated with it are enrolled into practice (see Appendix C4, p. 201 for details of analysis). Figure II (on page 90) captures the material and social elements that are woven together in the mediation of policy by the subject advisor. The associations formed amongst the elements look like multiple intersections and depict the “networky” effect of the actor network. In Part A of Chapter Two A I mentioned that the analysis demonstrates that the networks are outcomes that emerge from complex sets of relations among heterogeneous elements (Latour, 2005). It exposes what drives the practice of mediation of policy. Figure II also shows that good National Senior Certificate exam results are networked more frequently than the other actors during mediation of policy.

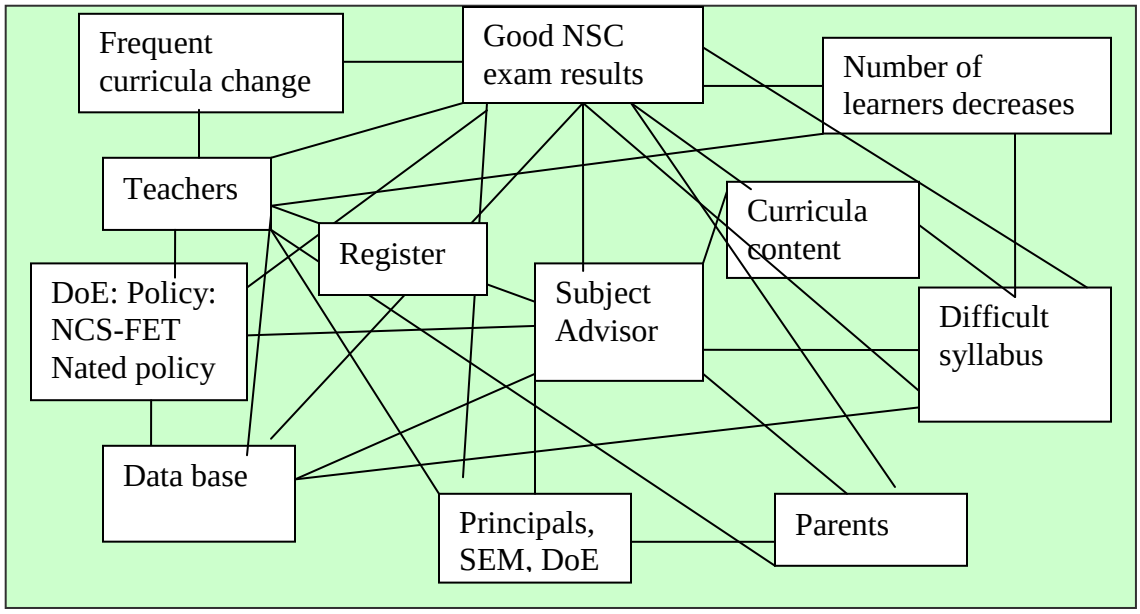


Figure II: Actors enrolled during mediation of policy at the DoE node

The enrolment of many actors at the DoE node and the associations among them depict how practice gets performed, how policy gets constructed, the optical density of the node and lastly SKAV constituted in practice.

4.2.1.1 Practice gets performed as negotiable moments of obedience seeking

During the mediation of policy the subject advisor skillfully and creatively involves the following actors e.g. good NSC exam results, criticism of stakeholders, NCS FET Life Sciences policy, attendance register, decrease in number of learners, exemplar exam paper. These actors are used to enact different realities and constructions of policy during the mediation process. Mediation of policy is not a smooth easy going process. It is a collage of tension, conflict, uncertainties and power dynamics that cohere together and hold the practice of mediation momentarily.

Mediation of policy began with the subject advisor using the attendance register to confirm teachers' attendance or absence from the training session. The register contains the names of the schools that were supposed to field a Life Sciences teacher to the

training. It the hand of the subject advisor the register is transformed into an instrument of power. It is used to wield his authority and display his hierarchal position of power, as is visible in the excerpts below:

> *"Do not sign for your friend who is not here. I could get you charged for misconduct"*
> Subject advisor, day one mediation of policy (see Appendix C, Annexure 3C, p.192)

> *"There are four errant teachers who have not signed the register as yet, school begins at 7:50. Now its 9:15. They don't have the decency to call and explain their absence or lateness"*
> Subject advisor, day one mediation of policy (see Appendix C, Annexure 3C, p.192)

The display of authority by the subject advisor mirrors how teachers are positioned during mediation of policy. Teachers are treated with disrespect (four errant teachers), mistrust (don't sign for your friend), and are subjected to hierarchical power relations (I could get you charged for misconduct). Mediation of policy gets performed as an autocratic obedience seeking process. The tension during mediation of policy surfaces and teachers respond to the subject advisors display of authority with criticisms about the untimely scheduling of the mediation session. Teachers construe the poor timing of the mediation session as imposing on their curriculum implementation time and placing them under undue pressure to meet a multitude of closely spaced deadlines as is evident below:

> *"What's irritating is the lack of consultation with us over the training date and time, this could or should have been done in the first week of December 2007"*
> Teacher, 5, day 1 mediation of policy, (see Appendix C Annexure 3C, P. 193)

> "*It cuts across the first term which is already so short, we are loosing valuable instruction time, we have to also field athletes to the IPSSA games in volleyball,*

netball and soccer and be on duty at these games. Admits this were is the time for the learners to get into the routine of serious academic work"

Teacher, 7, day 1 mediation of policy, (see Appendix C Annexure 3C, p. 193)

"This cuts across my teaching time, I will be away for the Math Lit training as well, that is 10 days away from school. I will have to rush with syllabus coverage, prepare learners for the first provincial controlled test, fund raise and get learners to participate in the IPSSA games, If the results are poor my principal will be mad at me"

Teacher8, day one mediation of policy, (see Appendix C Annexure 3C, p. 193)

The strained rapport between the subject advisor and teachers emerges. The subject advisor fidgets with his tie, checks his cellphone while he received the criticism about the poor timing of the training. He hurriedly introduces the 2007 NSC exam results. He distributes graphs and tables of the results. The graphs illuminate the pass rate of each school in the region while the tables depict the percentage pass rate, percentage failure rate, symbol distribution and rank the schools in this region according to their pass rate. The graphs and tables serve a two fold purpose, first, they structurally capture the link between good NSC exam results and best practice. Second, they are used as a trump card to negotiate with teachers and form alliances with teachers, the DoE and stakeholders. In other words, the graphs and tables are connected to teachers through various actors such as best practice, pedagogical identity and stakeholders' expectations. Practice therefore gets performed as negotiable moments. It is in this regard that Law (2009) argues that practice consists of resistance[18] on the one hand and repeated efforts or accommodation[19] to overcome them on the other hand.

Multiple ties are formed with good NSC exam results to produce a synergised effect at the DoE node. The alliances formed with good NSC exam results are used to negotiate and reduce conflict with other actors encountered in the mediation network, e.g. to ensure

[18] Resistance: failure to achieve the philosophical goals (Law, 2009, p. 5)
[19] Accommodation: Strategy of response to the resistance encountered during practice (Law, 2009, p. 5)

the survival of Life Sciences in the curriculum, to obviate stakeholders' criticism of the premature implementation of policy. The alliances formed with good NSC exam results help to stabilise the network and show how practice gets performed. The alliance network elucidates that the practice of mediation of policy gets performed as negotiable moments with good NSC exam results. The alliances formed with good NSC exam results are a strategy used by the subject advisor to enroll teachers for implementation of policy, to create the impression that policy is implemented successfully, to attract learners into Life Sciences, to affirm policy and to form alliances with teachers and the DoE.

As a result of the negotiations and alliances forged with good NSC exam results, the latter are transformed into a mediator and mobilise and translate the practice of mediation of policy. The repeated recruitment of good NSC exam results into the actor network highlights the subject advisors' non-compliance, non-alignment and divergence from the goals and intentions of the NCS-FET Life Sciences Policy. This is in terms of teaching approach, learner- centredness, and the kind of learner emerging from the FET phase. Good NSC exam results divert the mediation of policy from the intentions of the gazetted policy. The power of good NSC exam results as a credentialing agent becomes apparent at the DoE node. Good NSC exam results are used to enact different realities during the construction of policy. Each construction of policy brings to the fore the kind of work good NSC exam results does in relation to the practice of mediation of policy.

4.2.1.2 Policy construction

Policy is constructed in four ways viz. as superior, as premature and powerful, as a hindrance, and as endangered.

4.2.1.2.1 The construction of policy as superior

A power point slide was used by the subject advisor to affirm the NSC-FET Life Sciences policy in terms of its curricular content, teaching approach and assessment standard (AS). Teachers were referred to the relevant pages in the NCS-FET Life Sciences policy. In the process of affirming the NCS-FET Life Sciences Policy, the restrictive opportunities of the past (Nated policy) are contrasted with the expanded opportunities of the present (NCS-FET Life Sciences Policy), as reflected in the excerpt below:

> *"It's far superior to the Nated policy, it embraces IKS and evolution, it's not content driven, but learner centred."*
> Subject advisor day 2 mediation of policy (see Appendix C, Annexure C3, p. 196)

He used the power point slide to emphasize and demonstrate how the Nated 550 and NCS-FET Life Sciences policy differ as shown below:

> *"It's different from Nated 550; the learners are not expected to merely recall information, it favours the testing of SKAV."*
> Subject advisor day2 mediation of policy (see Appendix C, Annexure C3, p. 196)

In the conceptualisation of policy as superior, the subject advisor displays kinship and altruistic behaviour towards the NCS-FET Life Sciences Policy. Alliances are formed with the curricula content (it embraces IKS and evolution) hint of power relation between employer and employee. It is worth noting that the subject advisor forms part of the National Curriculum Development Team. He has no options but to form alliances with the DoE as this is his job. The novel AS of the policy (it favours the testing of SKAV) is used to induce the enrolment of good NSC exam results into the network. The subject advisor forms multiple alliances with good NSC exam results. Good exam results are used to negotiate and reduce conflict with teachers.

As mentioned before the NSC exam results are transformed into tables and graphs by the subject advisor and used to signal best practice and identify outstanding teachers, schools of excellence and underperforming schools. In other words, the graphs and tables are used by the subject advisor to depict a closely aligned association between good NSC exam results and best practice in a structural way. It is also used by the subject advisor to take ownership and accountability of the good NSC exam results (my schools), as shown in the excerpts below:

> *"I took the liberty of drawing ranking tables and graphs for my schools in terms of percentage pass rate and quality of passes"*
> Subject advisor day 1 mediation of policy (see Appendix C, Annexure C3, p. 194)

> *"I call it a table of consistency. These schools have maintained their 100% pass rate for the last five years in spite of the frequent curricula changes"*
> Subject advisor day 1 mediation of policy (see Appendix C, Annexure C3 p. 195)

> *"I hope the others have been making notes on these teachers' strategies; remember as teachers you are judged by your school matric exam results."*
> Subject advisor day mediation of policy (see Appendix C, Annexure C3, p. 195)

The enrolment of good NSC exam results creates tension and uncertainty at the DoE node in respect of teachers' pedagogical practice and identity. In the construction of teachers' pedagogical practice and identity, the subject advisor uses good exam NSC results to bestow qualities, desires, visions and motivations onto teachers. This arbitrary association between good NSC exam results and best practice highlights the tension and contradictory cartography during mediation of policy as is visible below:

> *"It's demeaning and embarrassing for us ….I didn't ask to be placed at a previously disadvantaged school….You don't know how hard it is to work in the conditions I face"*
> Teacher, 7 mediation of policy (see Appendix C, Annexure 3C, p.195)

"*We function in different working environments, our learners are different, their social problems are unique so how can you compare our result?"*
Teacher, 4, mediation of policy (see Appendix C, Annexure 3C, p.195)

It is this contradictory cartography that elucidates that action is not transparent during mediation of policy - and therefore has to be traced to be rendered visible. These tensions result in the construction of policy as premature and powerful.

4.2.1.2.2 The construction of policy as premature and powerful

The tensions and uncertainties that confront the subject advisor during mediation of policy ensnare him to frequently make reference to stakeholders' criticisms about the early implementation of the policy and the novel AS of the policy that ensue good NSC exam results. This action results in the paradoxical construction of policy as premature and powerful. This construction of policy reveals the dual nature of policy, which in turn highlights the contradiction and inconsistency within the policy and shows how policy is simultaneously negated and reinforced. The shortened timeframe between the formulation and implementation process and its goal of involving all stakeholders in its formulation is used to annul the policy as shown below:

"The public feels policy was implemented before schools and teachers were properly trained"
Subject advisor day 2 mediation of policy (see Appendix C, Annexure C3, p. 196)

Policy is affirmed in terms of its AS and associated good NSC results as is evident below:

"Good exam results will dispel fears and concerns of the public about implementation; it will stop criticism and good results will show that the curriculum is successfully implemented."
Subject advisor day 2 mediation of policy (see Appendix C, Annexure C3, p. 196)

The dual nature of policy reveals that alliances formed, e.g. with policy and the DoE, are not stable or fixed but are fluid in nature. These fluid alliances can lead to convergences, divergences and contradictions in the network created. When policy is construed as premature and powerful, the subject advisor forms alliances with Life Sciences teachers, good NSC exam results and the DoE.

The alliance formed with good NSC exam results demonstrates how these get enlisted during mediation of policy to confer a particular vision for policy implementation. Good NSC exam results are transformed into a negotiation tool that serves as a yardstick to validate implementation of policy as successful and the success of teachers' pedagogical practice, and to allay the fears of stakeholders. The alliance formed with good NSC exam results initially subverts policy in terms of teaching approach as well as the image of the teacher and learner, but reaffirms policy in respect of its curricula content. The fluidity of the alliance formed (re)emerges. These (re)alliances and (re)associations shift in response to the interest of the subject advisor to facilitate the practice of mediation of policy. The alliance formed unearths the strategies used by the subject advisor to enroll actors for implementation of policy. The shifting alliances formed reiterate that action is not transparent, it is dislocated, and it has to be traced to be illuminated.

The alliance formed with the DoE when policy is constructed as premature and powerful illuminates the power of the DoE and the subjugation of teachers as implementers of policy, as seen in the excerpt below:

> *"It's gazetted now and you have to teach it, that's the bottom line."*
> Subject advisor, mediation of policy day 4 (see Appendix C, Annexure C4, p. 199)

What becomes visible from this excerpt is that mediation of policy is performed in a hierarchal "top down" approach. The practice of mediation of policy illustrates how teachers are positioned by subject advisors during policy transformation. This positioning

of teachers exposes the micro politics of policy reform. The subject advisor resorts to using formal ("it's gazetted now") and informal ("you have to teach it") power to seek the obedience of teachers during mediation and implementation of policy. The subject advisor uses both formal and informal power to regulate the practice of teachers. This means that teachers have no option but to comply with protocol and the powers that be. Therefore, the practice of mediation of policy gets performed as obedience-seeking.

While an alliance is formed with the DoE, this alliance leads to subversion of the gazetted policy's vision for teachers as interpreters and designers of learning materials. The practice of mediation of policy gets performed as a way of "breaking away" or divergent from the gazetted policy's expectation for teachers. Furthermore, the subversion of policy in terms of teaching approach has implications for how enrolment of teachers occurs during mediation of policy. The conflicting nature of the alliance formed by the subject advisor with the DoE emerges. The analysis brings to the fore how actors do the sociology for the enquirer, and highlights what constitutes their associations. The analysis reveals that actors are defined in unstable sets of relations, which lead to the construction of policy as endangered.

4.2.1.2.3 Construction of policy as endangered

The statistics on the decreasing number of learners pursuing Life Sciences is used by the subject advisor, during mediation, to annul the NCS-FET policy in terms of its goal of broadening access to science, its curricular content and AS. This results in the construction of policy as endangered. This particular construction of policy alerts us to the dwindling number of learners pursuing Life Sciences in the FET band, as illustrated in the excerpt below:

> *"I'm aware that numbers of learners pursuing Life Sciences is decreasing, but our good results will attract more learners to Life Sciences."*
> Subject advisor, day 1 mediation of policy (see Appendix C, Annexure C3, p. 194)

The dwindling number of learners epitomises the tension, conflict and contradictions between policy mediation and policy goals. The alliances formed with good NSC exam results lead to affirmation of policy and policy goals in terms of broadening access into sciences. Good NSC exam results are enrolled to serve firstly, as a motivation to prevent the extinction of Life Sciences from the school curriculum (in South Africa Life Sciences is not a compulsory subject in the FET band), and secondly, as an agent that can reduce the conflict caused by the decrease in the number of learners pursuing Life Sciences. These results are construed as a magnet that can create a strong 'force-field' to attract learners into Life Sciences, thereby providing continued employment for Life Sciences teachers and subject advisors. The dwindling number of learners consequently results in the construction of policy as a hindrance.

4.2.1.2.4 Construction of policy as a hindrance

The dwindling number of learners pursuing Life Sciences and the comparisons of the NSC Life Sciences exam paper to other learning areas exam papers is used in the construction of policy as a hindrance. The construction of policy as a hindrance negates the NCS-FET Life Sciences Policy in terms of its curricula content and strategy for testing. An astonishing comparison is made between other learning areas and Life Sciences in terms of curricular content ("difficult length of syllabus") and examinations ("other subjects have no shocks"), as is seen in the excerpt below:

> *" It's a difficult, lengthy syllabus, other subjects have no shocks in the exam, I will take you through it step by step and show you what you need to focus on for good exam results… provide multiple opportunities for learners to master these testable competencies … remember practice makes perfect … use a drill method to teach."*
>
> Subject advisor, day 1 mediation of policy (Appendix C, Annexure C3, p. 194)

This particular construction of policy illuminates that the difficult, lengthy syllabus and different exam weighting serve as a barrier and social control mechanism for access to

Life Sciences (see 'Construction of policy as endangered'). It serves to multiply injustices by certifying learners' eligibility for access to science, universities, and better jobs. It is significant to note that the analysis reveals how networks get extended, e.g. when the difficult, lengthy syllabus identified by the subject advisor adds more actors such as exams, frequent curricula change, assessment and teaching into the network of mediation. The construction of policy as a hindrance reveals the alliance formed with good NSC exam results and teachers. As shown in Part A of Chapter Two, the analysis illustrates how actors are moved out of their intended path of action by some other agent, e.g. good NSC exam results.

The alliance formed with good NSC exam results serves to counteract the difficult curricula content and exam strategy and motivate teachers for curricula implementation. These alliances reduce the severity of the conflict with the difficult, lengthy syllabus and exams in Life Sciences. The alliance formed with good NSC exam results subverts policy in terms of teaching approach ("use a drill method"), the image of the learner ("practice makes perfect") and assessment practice ("master testable competencies"), but affirms policy in terms of curricula content.

4.2.1.3. Optical density of the DoE node

In each construction of policy many associations, ties and alliances are formed with the heterogeneous elements enrolled into the actor network created by the subject advisor. A glimpse is provided of how networks are put into place by actors. The discussion above (section 4.2.1.1. and 4.2.1.2.) illuminates the ties formed with the difficult, lengthy syllabus, curricula content, attendance register, policy, decreasing number of learners, frequent curricular change, stakeholders' expectations, and ultimately good exam results. The alliances formed at the DoE node map the structure of its alliance network, which is determined by the number of ties the conspicuous actor forms with any particular f(actor). The more ties an entity has, the more stable it becomes. The alliance network formed alters the optical density of the node and shapes how mediation of policy gets performed and which SKAV are constituted.

4.2.1.4. SKAV *constituted in practice*

The subject advisor engages teachers in an activity of classifying the questions in the exemplar question paper into the different LOs and ASs. In this activity of classification of the questions in the exemplar paper knowledge (SKAV) is being ascribed to teachers in terms of the weighting of LOs in the NSC exams and to assist them with the setting of assessment tasks for their learners. Therefore mediation of policy focused on the 'how' and 'what' in terms of the preparation of learners for exams. Meeting NSC exam requirements forms the crux of the mediation process, as shown in the excerpt below:

> *"I'm on the exam panel, I design the mediation to focus on exams"*
> Subject advisor, day 2 mediation of policy (see Appendix C, Annexure C3, 197)

> *"You must provide multiple opportunities for learners to master these testable competencies."*
> Subject advisor, day 2mediation of policy (see Appendix C, Annexure C3, p. 196)

The alliance formed by the subject advisor with NSC exams translates SKAV development into a cookbook recipe for good NSC exam results. The analysis elucidates the contradictions and tensions between mediation of policy and the gazetted policy in terms of AS and teaching approach. The SKAV needed to pass the NSC exams (testable competencies) become foregrounded as the sole ingredients in the recipe for success. It is worth noting that LO1 competencies constitute 40% of the exam paper weighting, LO2 40% and LO3 20% (DoE, 2006). This means that teachers are not enrolled with all the SKAV gazetted (see Part B of Chapter Two, section 2.2.6 for competencies to be developed) in the NCS-FET Life Sciences Policy. This is illuminated in the excerpt below:

> *"Focus on hypothesis testing, translation of data, drawing tables and graphs, identifying trends and concepts, terms, use past year exam papers for examples,*

include all competencies in assessments so they can be mastered and learners can pass well."

Subject advisor, day 2 mediation of policy (see Appendix C, Annexure C3, p. 196)

The number of SKAV that teachers are enrolled with is pared down compared to the gazetted requirements of the policy (twenty eight LO1, nine LO2 and ten LO3 competencies). SKAV constituted during mediation of policy lead to subversion of the policy in terms of the goals of the policy with regard to human resources development and overcoming the skills shortage, the image of the learner (linked to exams and performance), and the AS of the policy. The constitution of certain SKAV during mediation of policy has serious implications for the implementation of policy at a micro level and human resources development at a macro level.

What comes to the fore with regard to enrolment of teachers for policy implementation is the selective enrolment of teachers to meet exam requirements. Mediation of policy is supposed to craft pedagogical change in teachers for implementation in line with the intentions of the NCS-FET Life Sciences Policy. The findings highlight that in comparison with DoE gazetted policy, different patterns of curriculum practice - that were not what they were "supposed to be" - surface. Practice gets performed in ways that can be described as sitting differently or divergent from the gazetted expectations of implementation and mediation.

The repeated recruitment of good NSC exam results during mediation of policy clarifies the subject advisors' preoccupation with the latter. It also exposes the tension and contradictory cartographies between mediation of policy and the gazetted policy goals. This has implications for the professional development of teachers, policy implementation and SKAV development. My finding highlights that the gazetted policy remains a symbolic gesture that is not fully embraced or espoused into the actual practice of mediation.

4.2.2. Schools node

At the schools node I aimed to answer the question: *How is policy constructed and which SKAV are constituted in practice at the schools node?* Presentation of the findings follows a similar pattern as outlined for the DoE node. My analysis (see Appendix D, Annexure D4, p. 193 for analysis) reveals that policy implementation involves more than the performance of a single powerful actor. Figure III below reflects the actors enrolled (resources, competing agencies, exams, frequent curricula change, stakeholders, poor training received, learners) by the teachers during implementation of policy, and the ties between the enrolled actors.

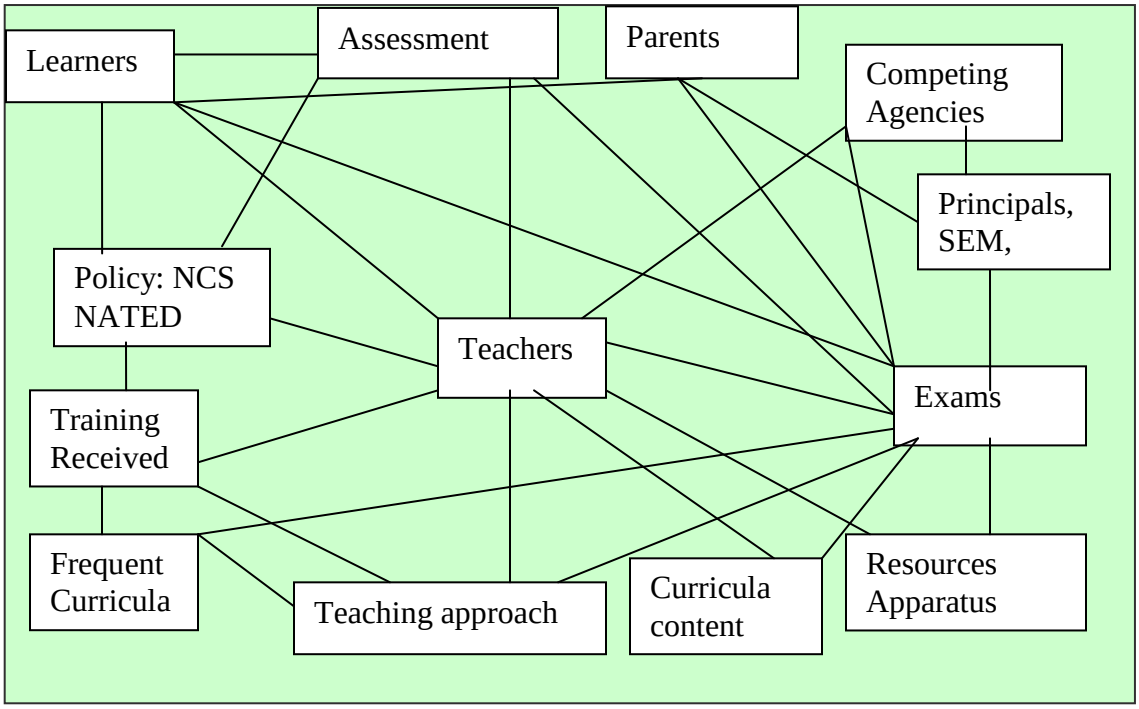


Figure III: Actors enrolled into implementation of policy at the schools node

These actors influence how implementation of policy gets performed, how policy gets constructed, the optical density of the school node and which SKAV get constituted into practice. At the schools node policy gets performed as a juggling act.

4.2.2.1. Practice performed as a juggling act in a dynamic ecosystem

The multifaceted associations formed with the heterogeneous elements during policy implementation disclose the complexity of the schools node and the competing agencies within its actor network. Policy implementation may thus be seen as an ecosystem with competition, co-operation, frequent environmental changes and development among organisms. These agencies bombard teachers and vie for space and time during policy implementation. Teachers have no choice but to deal with these compromising entities as and when they arise. In the process, teaching is illuminated as a complex and demanding task where teachers have to develop strategies that allow them to make decisions, investigate problems and understand learners' needs simultaneously. As a result, implementation of policy gets compromised and practice gets performed as a juggling act for space and time.

To cope with the constant daily juggling they have to endure, teachers form an investment alliance with the NSC exams, which benefits both learners and teachers as reflected below:

> *"It simple we structure our lessons with the exams in mind, so that our learners can excel in the exams. Also during our training session with the subject advisor he emphasised hypothesis testing and planning investigations so much that it's a certainty in the paper. So we focus on that. We want our learners to excel in the exams, then we also look good, the principal will be happy, SEM is thrilled and feels he is responsible for the results. The end result everybody is happy and you are not bugged about your results at meeting"*
>
> Teacher 1, focus group interview (see Appendix D, Annexure D6, p. 230)

Good exam results have multiple benefits at the school node. Learners who get good NSC exam results have access to university and jobs. Teachers' pedagogical identities are associated with best practice, when learners acquire good NSC exam results it also affects

their IQMS scores and salaries. The competing agencies at the schools node command recurring alliance formation with the NSC exams.

Practice being performed as a juggling act reflects the complex relational embeddedness of multiple agents teachers encounter during policy implementation as is visible below:

> *"They are oblivious of the other demands made on us. We have sport, fund raising, admin work, relief teaching, marking of assessments, collection of funds, coping with social problems of learners, we serve as counselors, welfare workers, police. They don't see the time constrains we are faced with on a daily basis. They see the curriculum unfolding from their offices in Pretoria or Truro house with no interruptions to teaching time"*
> Anecdotal image 5, see Appendix D, Annexure D2, p. 215)

The meaningful language (oblivious, other demands made on us, don't see constraints we face)) in the excerpts above show how practice is sustained as part of the ongoing reconfiguration occurring during policy implementation. Practice being performed as a juggling act shows that policy implementation does not occur in the vacuum envisaged by the DoE but in the evolving dynamics of the schools ecosystem. Therefore, the gazetted policy is not a "stable thing" to be implemented as proposed, it evolves in the school environment. As it evolves it gets (re)produced, (re)constructed in certain ways within the practice of implementation. Each construction of policy shows how teachers and material agents are reciprocally intertwined in this struggle.

4.2.2.2. Policy construction

At the school node policy is constructed in four ways viz. as experimental, mutating and estranged; as an alien invader; as a game and as a hindrance to implementation.

4.2.2.2.1. Construction of policy as experimental, mutating and estranged

Teachers use their lived experiences of frequent curricula change to bring to the fore the tensions and uncertainties they encounter during curriculum policy reform. These tensions and uncertainties teachers encounter leads to the construction of policy as experimental, mutating and endangered. This particular construction of policy signals the disempowerment, destabilisation, foreignness, anxieties, tension and uncertainty teachers stumble upon during policy reform and implementation. The excerpts below portray policy as being a repeated clinical trial process, as foreign or lacking familiarity with teachers, and as an abusive experiment conducted on teachers:

> *"We are both guinea-pigs in DoE's experiment, we didn't have a say in drawing up this curriculum. Now we have to implement it successfully"*
> Teacher 1 (focus group interview, see Appendix D, Annexure D6, p. 230)

The excerpts below clarify how teachers are "othered" by the curriculum formulation process and the power relations they encounter.

> "*Every time there is a new minister of education there is a new policy"*
> Teacher 4, (focus group interview, see Appendix D, Annexure D6, p. 230)

> *"I'm just so sick of all this inadequate training, re-training, deskilling, reskilling, trying to implement this curriculum only to have it changed before I get the hang of it"*
> Teacher 3 (focus group interview, see Appendix D, Annexure D6, p. 231)

These excerpts reveal that teachers allude to power relations during the policy-making process. Furthermore, they concur with the findings of the preliminary survey (see Chapter One). These excerpts show that implementation of policy is a hierarchal "top down" process, with teachers reduced to a lower status ("guinea-pigs"). This illustrates how teachers are positioned by the DoE and subject advisors during policy

transformation. These power relations reflect the tension between those with access to resources and those without (see Chapter One, pp. 9 and 10), and also between those whose opinions are valued and those whose opinions are ignored. This finding indicates that unless these power issues are made apparent and are addressed, they will continue undermining policy implementation and SKAV development. What comes to the fore is that teacher inputs are not valued during the policy reform process.

The construction of policy as experimental, mutating and estranged makes apparent the iterative scaffolding process that occurs during the reconstruction of our education landscape ("only to have it changed before I get the hang of it"). The analysis depicts the uncertainties teachers encounter during curriculum policy reform, and illustrates that the policy-making process ignores the teachers' experiences ("sick, reskilling, deskilling, trying") in dealing with frequent mandatory policy changes. The frequent curricula change that teachers encounter (reskilling and de-skilling) reflects the contestation they experience from their exclusion from the policy-making process ("we don't have a say"). The above excerpts also highlight the anxieties about transition that teachers encounter when subjected to frequent curricula change, in terms of who they are and who they should be. Teachers are overwhelmed by the frequent changes, become disempowered, and feel uncertain about their pedagogical practice. The frequent de-skilling and reskilling leads to teacher frustration and leaves them in a state of "limbo". They never seem to be able to meet their own expectations and are uncertain about meeting the many expectations of other actors. As a result, practice gets performed with uncertainty.

The uncertainty that teachers encounter during policy reform and the pressure from subject advisors and stakeholders' expectations to demonstrate their competence in the implementation of policy, drives teachers to form alliances with NSC exam results as reflected below:

> "*We need to show that we are* au fait *with the content and requirement of the curriculum. One way of illustrating this is by teaching for the exams so learners can acquire good marks."*

Teacher 2 (focus group interview, Appendix D, Annexure D6, p. 230)

Superficial linear associations are therefore perpetuated between good NSC exam results and successful implementation of policy. These results are equated with teachers' competence with curricula content. Therefore, the alliance formed with the NSC exam results leads to subversion of policy goals in respect of the vision for teachers and learners and curricula content, and controls SKAV development. Practice gets performed as a dress rehearsal for the NSC exams ("*teach for exams"*). The power the NSC exams exert over implementation of policy surfaces. Alliances are also formed with learners to achieve a positive outcome and to affirm their role in their performance. This linear relationship between good NSC exam results and best practice is perpetuated by teachers themselves at the school node. The above excerpts bring to light how teachers shape and construct their professional identity. Good NSC exam results become a credentialing agent for teachers as well. The uncertainties, conflict and tensions that teachers encounter leads to the construction of policy as an alien invader.

4.2.2.2.2. Construction of policy as an alien invader

Teachers use the various activities they engage in such as fund raising, sport, admin work, attending meeting, students' social welfare issues elucidate the laborious process of teaching. These actors illuminate the web of socio-material actors that impact on implementation of policy and exacerbate teacher anxieties, tensions and uncertainties. Hence policy is constructed as an alien invader. The NCS-FET Life Sciences Policy is contradicted in terms of its vision for policy implementation, its envisaged teaching approach, and the image of the teachers and learners. This construction of policy elucidates that curriculum implementation does not occur in a vacuum, and that other agencies vie with policy for space and time, as reflected in the excerpt below:

> *"There are many dynamics within the school situation that impact on our teaching time such as curtailment of teaching time for fund raising activities, attending to social welfare issues like house parties, drugs and alcohol abuse,*

sport, observing peers' lessons for IQMS, completing admin work, stats returns for department or district office, dealing with discipline issues on a daily basis; therefore it's easier to teach for the exams."

Teacher 3 (focus group interview, Appendix D, Annexure D6, p. 230)

"*They lack an understanding of the dynamics of a school in terms of time available for teaching, on paper it seems there is enough time, but our lessons are often curtailed to complete forms, fund raise, sports, debates, attend to social welfare issues of learners, attend meetings in the evenings and weekends, often people think teaching is a 7:30 to 2:30 job, its not I barely have time for my own children, when I teach I'm forced to focus on the exam requirements only, there is no time to teach for understanding social justice issues"*

Anecdotal image 4, journal entry, (Appendix D, Annexure, D2 p. 214)

These competing agencies, such as fund raising, sport, departmental stats, discipline issues, social welfare issues and IQMS create divergences in the network of policy implementation (impact on teaching time) and subvert policy goals. Teachers allude to the pressure of these competing agencies and form alliances with the NSC exam results ("*teach for exams"*). The alliance formed with the NSC exams is intended to reduce the severity of the conflict teachers encounter over the contestable f(actors) like time and space. Valuable teaching time gets juggled with competing entities, and implementation of policy gets performed as a juggling act. The metaphor of juggling connotes competing agencies maintained in continuous motion. The teacher is the juggler who engages in this balancing act to prevent competing agencies from collapsing onto him/her. Juggling becomes an adaptation strategy for survival and continuity in the network. The perpetual juggling results in the construction of policy as a game.

4.2.2.2.3. Construction of policy as a game

Teachers understanding that their pedagogical identity is constructed by the type of exam results their learners produce imply that they competently participate in the practice of connecting these two concepts during policy implementation. This leads to the construction of policy as a game. The NCS-FET Life Sciences Policy becomes invalid in respect of its philosophy, AS, teaching approach and vision for teachers and learners when policy is constructed as a game. The notion of policy as a game dismisses policy as an arbitrary exercise, for which teachers have developed manageable mechanics of play, as can be seen in the excerpts below:

> *"It's a win- win situation for all of us and everybody is happy. So I do what I can with the poor training I receive, I teach for the exams"*
> Teacher 5 (focus group interview, Appendix D, Annexure D6, p. 230)

> *"I don't worry too much about the philosophy of the curriculum as it's not my vision for learners, I teach for the exams, so I look good when the learners' exam results are good"*
> Teacher 3 (focus group interview, Appendix D, Annexure D6, p. 231)

> *"We are judged by exam results, everybody expects good results so why not teach for exams? These results will go on their CAO forms for university entrance and, my IQMS rating will be high."*
> Teacher 1 (focus group interview, Appendix D, Annexure D6, p. 230)

> "*We are under tremendous pressure to produce good results by the subject advisor, SEM, principal and parents. We are judged by these results, if the results are good they are good managers and its like we have nothing to do with I, they are responsible for the teaching, if the results are not up to expectation we are poor teachers"*

Anecdotal image 2, journal entry, (AppendixD, Annexure D2, P. 213)

The excerpts above highlight that policy implementation is reduced to a high-stakes game (*"win-win situation"*), with good NSC exam results being the valued prize for learners and teachers. Thus, practice gets performed as an investment game, whereby deposits are made by teachers into learners. To secure the investment, alliances are formed with the NSC exam results and learners. The alliances formed with learners serve to motivate and instill qualities and a particular image of success in learners in order to affirm them and their progress. Deposits into learners are construed as an investment that allows learners access to university.

The investment returns for teachers are that good NSC exam results get equated to best practice. The implications of this investment game are that teachers use learners' performance in the NSC exams to validate their own success as teachers. This leads to subversion of policy goals in terms of the kind of learner emerging from the FET band. The NSC exam results are used as a yardstick for measuring good practice, IQMS scores, the efficacies with which teachers implement policy and learners' access to tertiary institutions. The expectations that stakeholders have of teachers in respect of exams confirms the centrality of the NSC exams at the schools node, as well as how teachers' identities get constructed by the NSC exam results. The centrality of the NSC exam results in the construction of policy as a hindrance.

4.2.2.2.4. Construction of policy as a hindrance

Teachers use the difficult lengthy syllabus, difficult exam papers in Life Sciences and the poor training they receive to depict the barriers, challenges and impediments they encounter during policy implementation. The emergence of these actors during policy implementation results in the construction of policy as a hindrance.

The NCS-FET Life Sciences Policy is annulled in terms of its curricula content, strategy for testing and vision for teachers when policy is constructed as a hindrance. Policy is

depicted as an enemy to its own goals and vision for education. It shows the imposition teachers encounter in their engagement with policy, as reflected in the excerpts below:

> *"Other learning areas do not have lengthy content, difficult exam papers or two exam papers"*
> Teacher 1 (interview, Appendix D, Annexure, D6, p. 230)

> "*Learners have difficulty in reading and understanding the language of science, biology has its own vocabulary and language, learners find the terminology difficult to comprehend, the wording of the questions are not straight forward, learners have to deconstruct the questions many times before they can answer it. The papers are set in English so the majority of my learners who are second language English speaker are faced with these challenges, so the exam paper set denies access to learners in Life Sciences, instead of broadening access"*
> Anecdotal image 3, journal entry, (AppendixD, Annexure D2, P. 213)

> *"Other subjects have more A's than Life Sciences in the National Senior certificate exams, their papers are not long with difficult language"*
> Teacher 3 (interview, Appendix D, Annexure D6, p. 230)

> *"Its easy for them to stand in the front during the training session and tell us to implement the curriculum but we would rather have a practical demonstration, a show and tell of how to do it in our classroom."*
> Anecdotal image 5, journal entry, (AppendixD, Annexure D2, P. 215)

> *"So I do what I can with the poor training I receive. I don't worry too much about the philosophy of the curriculum as it's not my vision for learners, I just focus on exam requirements."*
> Teacher 2 (focus group interview, Appendix D, Annexure D6, p. 231)

The construction of policy as a hindrance illuminates teachers' discontent and irritation with the mediation of policy ("tell us what to do", "poor training"), the lengthy curricula content, difficult exam papers, and their lack of involvement in the policy formulation process. Teachers are discontent with the poor top-down professional development ("*poor training I receive"*) they receive during policy reform. The kind of professional development offered to teachers is not aligned with the philosophical orientation of policy, and leads to subversion of policy.

The lack of involvement of teachers in the curriculum policy-making process becomes an insurmountable barrier that inhibits them from sharing or embracing the NCS-FET Life Sciences Policy's philosophy for education. The lack of consultation with teachers results in obligatory alliance formation with the DoE, and leads to subversion in the Policy's vision for learners, teachers, ASs and teaching approach. Teachers are asking to be consulted about policy reform as well as the type of professional development and support they require during policy reform ("show and tell"). This means, that teacher development should be done with teachers - and not to them.

As a consequence of policy being a hindrance (*"lengthy content", "difficult exam papers", "not my vision"*), teachers form alliances with the NSC exams and teach with the specific aim of satisfying examination requirements (*"focus on exam requirements"*). The alliance formed with the NSC exams exposes the ways that networks of relations are composed, and how alliances are made durable to cope with impediments. This alliance with exams invariably subverts policy in terms of its image of teachers and learners, and the development of critical thinking and problem solving in learners.

4.2.2.3. Optical density of the schools node

The optical density of the schools node is determined by the ties among the heterogeneous elements in the network created by the teachers. Ties are formed with difficult syllabi, competing agencies, reskilling and de-skilling, frequent curricula change, poor training, lack of consultation in the policy reform process, learners, the NSC

exams, and good NSC exam results. These heterogeneous elements alter the optical density of the schools node, dislocate teaching from its intended (gazetted) path, and are responsible for the refraction that occurs in the schools node. Each construction of policy allows for the NSC exams to empirically rear their head in multiple ways. The multiple alliances formed with the NSC exams at the schools node elucidates the power that these exams exert over teachers in their teaching and classroom practice. The credentialing agency of the NSC exams resurfaces and interferes with SKAV constituted in practice.

4.2.2.4 SKAV constituted in practice

The development of SKAV is embedded in practice. This means that it is an effect of and an implication of situated practice of teachers. While teachers were enrolled during mediation of policy to use a drill method to teach, in a discrete way their practice espouses the philosophy of the NCS-FET Life Sciences Policy in terms of learner-centredness. The excerpts below highlight the alliances teachers form with socio-material actors such as microscopes, books, charts, hand lenses and specimens to engage in a constructivist approach during teaching and SKAV development:

> *"I will demonstrate how to make a slide of leaf epidermis before you undertake the investigation. You work in groups, this is a hands-on prac activity"*
> Teacher 1 (observation of lesson, Appendix D, Annexure D6, p. 222)

> *"You could use your textbook to answer questions … use the hand lens to observe the specimen. make a slide to observe the specimen under high power, then identify, compare"*
> Teacher 1 (observation of lesson, Appendix D, Annexure D7, p. 222)

> *"Look at the chart of Futi and Dolly the cloned cow and sheep"*
> Teacher 2 (observation of lesson, Appendix D, Annexure D7, p. 225)

> *"Pay attention to the video of 'Look who's talking'…Copy the terms from the board."*

Teacher 4 (observation of lesson, Appendix D, Annexure D7, p. 225)

These excerpts elucidate divergence and discrepancies between mediation of policy and implementation of policy in terms of teaching approach. These teaching approaches engage learners in developing LO1 (demonstrate - follow instructions, work in groups, observe, investigate, identify, record, manipulation of apparatus); LO2 (use your textbook to answer - accessing, interpreting information) and LO3 (pay attention to the video of "look who's talking" - application of science to society, attitudes and beliefs) competencies. The teaching approach focuses more on the teaching of LO1 competencies related to AS1 (basic science process skills), LO2 competencies related to AS1 (knowledge) and AS2 (and comprehension) and LO3 competencies related to AS3 (application of science to society, attitudes and beliefs). The divergence in respect of teaching approach between mediation and implementation of policy also leads to affirmation of policy and convergences in the network of policy implementation. Thus, during implementation of policy teachers constitute the following SKAV in their daily assessments:

> *"hypothesis testing, translation of data, recognizing trends, organisation, presentation, observe, identify, investigate, predict, microscopy, explain how you extracted DNA, application, analyze, prac work, compare, access information, terminology concepts, essay writing , group work."*
> Teacher number1 (focus group interview, Appendix D, Annexure, D7, p. 230)

The excerpt above shows convergences with mediation of policy in terms of SKAV development in respect of LO1 and LO2. Although teachers tend to foreground SKAV considered to be highly testable in the NSC exams by the subject advisor, they also develop competencies in their learners that are in the gazetted policy. Due to their teaching and assessment approach, teachers also engage learners in other LO1 competencies (organisation, presentation, microscopy, follow instructions, observations, recording, application, analysis). In a subdued way teachers do develop LO3 competencies in their learners by engaging them in group work, debates and writing

essays that seek their opinions on the impact of science and technology in their lives and require learners to compare past and present opinions on scientific development. Teachers affirm the policy in terms of LOs and SKAV development and this leads to convergences in the network of policy implementation.

4.2.3 Industry node

At the industry node my aim was to answer the question: *How is policy constructed and which SKAV are constituted in practice by industry using the application of biotechnology in the NTEW?* Findings are presented in the same way as for the DoE node.

The analysis (see Appendix E6, p. 246) at the industry node reveals that the actors enrolled into the network are the DoE, curricula content, excursions, different teaching approaches, exams, teachers, NTEW, and rapport with mentors. These heterogeneous elements are reflected in Figure IV below.

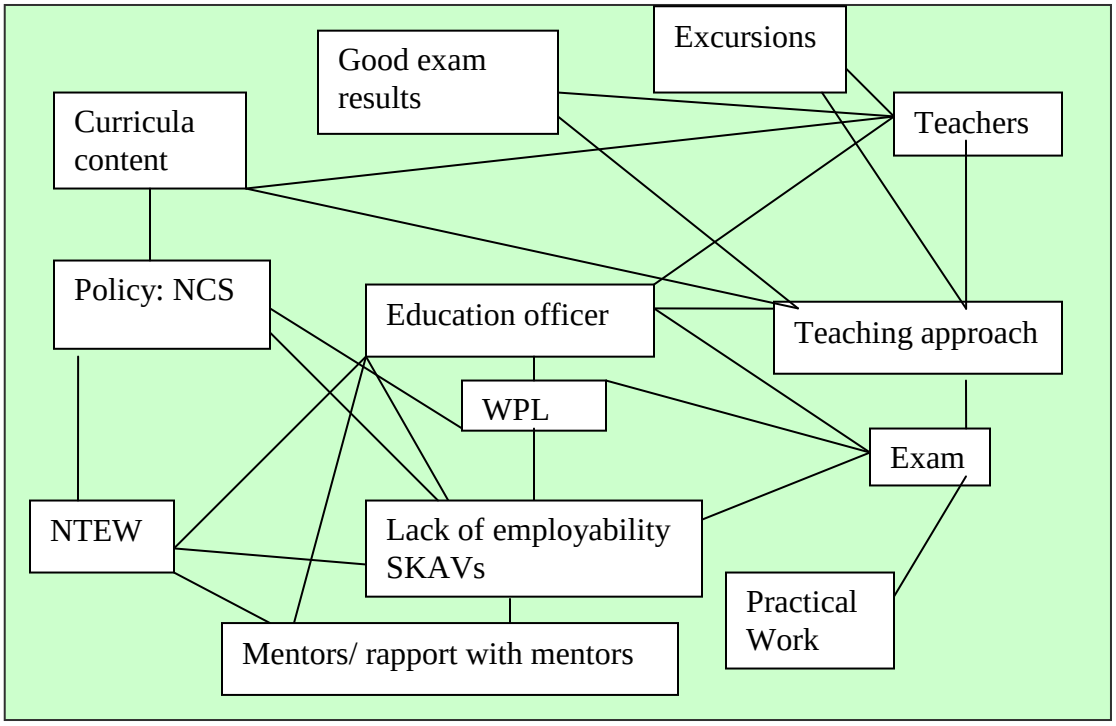


Figure IV: Actors enrolled into mediation of workplace learning

The ties among these heterogeneous elements influence how practice gets performed, how policy gets constructed, the optical density of the industry node and the SKAV constituted in practice.

4.2.3.1. Practice gets performed as a construction process

Life Sciences (biology) is a pre-requisite for all NTEW employed in the production room of this industry. When prospective NTEW employees are being selected for a job, in this industry, they are subjected to an interview (oral) and an aptitude test (written). The interview is used to establish the NTEWs communication skills, loyalty, levels of personal hygiene, customer care, ability to resolve conflict. The written test is used to ascertain the NTEWs ability to identify apparatus used in a laboratory at school level, list how these apparatus are used, perform simple calculations and conversions, identify elements and compounds, test their knowledge on human physiology. The selection of NTEWs for employment depends on the interview and test score. The test is set by the education officer and evaluated by an external agent that also vets this company's work plan learning programme. The work place learning programme uses the SKAVs developed in Life Sciences at school as an elementary platform for the development of SKAV required in this industry as shown in the excerpt below:

> '*I design the work place learning programme on the basis that certain entry level SKAV are developed in the school Life Sciences curriculum"*
> Education Officer, interview, (Appendix E, Annexure E2, P. 238)

As a result of the alliances formed at the industry node with the DoE, schools and the curricular content of policy, the mediation of workplace learning gets performed as a construction process. The construction process entails building on the SKAV developed at school in order to meet the SKAV requirements of this particular industry and it influences the construction of policy at this node.

4.2.3.2. Policy construction

Policy is constructed in two ways viz. as a building block and as a hindrance.

4.2.3.2.1 Construction of Policy as a building block

The entry level SKAV displayed by the NTEWs in their aptitude test leads to the construction of policy as a building block for work place learning. This construction of policy affirms the NCS-FET Life Sciences Policy in terms of its curricula content. The curricula content of the Policy creates the rudimentary foundation in terms of SKAV requirement in NTEW. This rudimentary foundation is converted into a building block for the development of SKAV required in this industry, as shown below:

> *"Life Sciences curriculum has provided us with key competencies needed in this industry and core knowledge required in industry."*
> Education Officer (interview, Appendix E, Annexure E2, p. 238)

When policy is constructed as a building block for workplace learning, alliances are formed with the DoE and schools. The alliance with the DoE and schools affirms the policy for its constitution of certain SKAV in learners who entered the world of work in this particular industry using the application of biotechnology (see Appendix E, Annexure, E6, p. 238 for exact SKAV). Hence there are convergences in the network of SKAV development. The alliances formed with schools bestow qualities, desire, vision and the motivation of industry onto schools to prepare learners for the world of work. The contested role that schools should play surfaces.

4.2.3.2.2 Construction of policy as a hindrance

The inability of NTEWs to display certain employability SKAV results in the construction of policy as a hindrance. The NCS-FET Life Sciences Policy is negated in

terms of its curricular content, teaching approach, and AS when policy is constructed as a hindrance. The policy's curricula content and AS is depicted as an obstacle to industry's agenda for SKAV development, as can be seen below:

> "*Curriculum should be more focused on preparing learners for world of work, have more practical based lessons ...Could be more useful if teachers taught it differently…everything is so exam-driven…curriculum must be linked to industries … have excursions to industries so learners and teachers could see what type of job opportunities are available and what skills are needed for these jobs…teachers are always rushing through the syllabus and are pressurized for good results by principal, parents and everybody."*
> Education Officer (interview, Appendix E, Annexure E2, p. 238)

Industry, it seems, has an expectation of schools to provide well-skilled workers in order to meet their demands with regards to SKAV development. They do not see schools as having other roles. The alliance formed by the education officer with schools also leads to subversion of policy in terms of the constitution of SKAV, and assessment approach ("*everything is exam-driven"*). The emergent effects of policy reveal the contradictory nature of the alliances formed. In other words, alliances formed with an actor can lead to convergences or affirmations as well as divergences or subversions. The fluidity of the alliances formed comes to the fore. A glimpse of the pressure that teachers encounter during policy implementation ("*rushing through the syllabus"*) resurfaces at the industry node ("*pressurized for good results"*). While the construction of policy as a hindrance leads to subversion of policy in terms of SKAV constitution, it also leads to alliance formation with NTEW. Alliances are formed with NTEW to supplement their SKAV development in order for them to become functional employees.

4.2.3.3. Optical density of the industry node

The optical density of the industry node is determined by the ties among the heterogeneous elements in the actor network created by the education officer, mentors

and NTEW. The discussion above (section 4.2.3.1.) illuminates the ties formed with schools, the DoE, curricula content, excursions, different teaching approaches, stakeholders, exams, teachers, and the attitude of NTEW. These heterogeneous elements alter the optical density of the industry node and influence SKAV constituted in practice.

4.2.3.4. SKAV constituted in practice

Mediation of workplace learning foregrounds the SKAV needed in this industry. The excerpt below shows how these SKAV are developed in NTEW:

> *"I design workplace learning to complement, develop competencies required and develop employability SKAV. Workplace learning entails formal exams and practical testing – hands-on activities. This entails practicing competencies repeatedly until mastered."*
> Education Officer (interview, Appendix E, Annexure E2, p. 238)

What is evident from this excerpt is industry's dependence on SKAV developed via the Life Sciences Policy at school. These SKAV are a prerequisite for the design of the workplace learning programme. There are thirty three employability SKAV (see Appendix E3, p. 238 for these) that are developed in NTEW during workplace learning. Once again industry's expectation of schools comes to the fore. In developing these thirty three SKAV NTEWs are repeatedly exposed to apparatus, chemicals, measuring, calculations, storage procedures and safety precautions that need to be followed in the production room. The NTEWs engage in many activities, on a daily basis during their work place learning. Some of these activities are familiar and some are novel. The repeated connectivity with these activities during work place learning does the reality of SKAV development. Work place learning is a performative productive practice. It engages NTEWs in activities that allow them to master the SKAV needed in this industry. Therefore, work place learning is a concoction of activities, cognitive and social arrangements clotted together to facilitate the development of SKAV.

It is also interesting to note the preoccupation of the education officer with exam and mastery of competencies during workplace learning. In the construction of policy as a hindrance (industry node), schools were criticised for foregrounding exams, as seen in the excerpt below:

> *"Everything is so exam driven,…teachers are always rushing through the syllabus and are pressurized for good results by principal, parents and everybody."*
> Education Officer (interview, Appendix E, Annexure E2, p. 238)

This leads to convergences in networking of SKAV development between the industry and schools node, and affirmation of policy in terms of assessment practice and teaching approach.

4.3. Conclusion

In this chapter I assembled the data from three nodes to answer the first research questions posed by this study. The data at the each node expose the unsuspecting sets of actors that are enrolled into practice at the DoE, schools and industry node. The enrollment of these actors into the practice network shows, firstly, that the conspicuous human actor is not a single performer during practice; secondly, that action is not transparent - it has to be traced; and thirdly, that practice gets performed in multiple ways by multiple actors. Some of these behind-the-scene actors, e.g. good NSC exam results, sometimes form multiple associations and alliances within the network.

The alliances formed are collaborations, acts of persuasion and coalitions among actors in order to pool their efforts, reduce conflict, bring about change in the actors networked and ensure that practice gets performed. Therefore, I speak of an 'alliance network' to indicate the interconnectedness of an entity and its "thickness of attachment" that stabilises the network (Latour, 1988, p. 30). This means that alliance formation involves negotiations and compromise between actors about the goals to be attained.

The alliances formed expose the contradictory cartographies and tension with the network. In the alliance formed, one actor becomes the agent of change. It is these alliances that indicate where the gaps are in this network, which associations are failing the propagation of the network, which need to be strengthened and which cause translations in the network. The evolving alliances formed demonstrate that actors are defined in unstable relations. The analysis reveals that the tensions, contradictions and uncertainties result in subversion of policy.

The alliances formed alter the "optical density" of the node and impinge on how practice gets performed. It is only when the alliance network stabilises momentarily that we are able to see how practice gets performed. How practice is performed determines which SKAV are constituted in practice. Thus the alliances formed make visible the socio-material context, reality or ontology of the nodal networks. In other words, the social (socio-material reality) emerges via the ties or association formed.

The findings at the DoE node indicate that policy gets constructed as superior, as premature and powerful, as endangered and as a hindrance, and only three LO1 and one LO2 SKAV are foregrounded. At the DoE node good NSC exam results are foregrounded in each construction of policy. The subject advisor forms strong alliances with good NSC exam results, which become isomorphic[20]. Good NSC exam results drive the mediation of policy – competencies testable in the exams become the focus of mediation of policy. Good NSC exam results become a mediator that alters the optical density of the DoE node. Due to the residual effect of these good NSC exam results, the alliance network evolves and restructures itself at the schools and industry node as the exam alliance network. The subject advisors' preoccupation with good NSC exam results sets a ceiling on teachers' enrolment of policy. The centre stage of the mediation performance is conducted by these exam results. This finding dispels the myth that the subject advisor is in control of the mediation process. The role of materiality in the mediation process

[20] Isomorphic: The growth of an actor is the result of its many ties.(Stalder, 1997)

comes to the fore. Good NSC exam results become a mediator that alters the optical density of the DoE node.

Policy gets constructed as experimental, estranged and mutating, as a game, an alien invader, and as a hindrance at the school node. The NSC exams flourish in each construction of policy, as teachers form alliances with the NSC exams. The NSC exams transform into a mediator and alter the optical density of the schools node with the many associations they form in the school actor network.

At the industry node policy is constructed as a building block for workplace learning and as a hindrance. The actors enrolled into the network at the industry node that alter the optical density of this node are exams, teaching approach, mentors, and lack of employability SKAV.

The assemblage of heterogeneous entities at a nodal level has exposed the tension, uncertainties, contradictions and alliances within the network. At a theoretical level the analysis emphasises the interconnectedness among the actors in the network. The analysis endorses that action is the result of network(s) constructed by actors. It demonstrates that networks are complex sets of relations among heterogeneous entities. Furthermore, the analysis indicates that the process of assembling and stabilising a network involves constant detours caused by the other entities, e.g. the NSC exams. Every time a new entity is approached, one has to make a detour to determine if it can play a role in the assembly, and whether it needs to be associated or disassociated.

The nodal networks created during the assemblage process are (re)assembled in Chapter Five.

CHAPTER FIVE

EMERGENT EFFECT OF CURRICULUM POLICY REFORM

"If what is assembled is not first opened up, de-fragmented and inspected,
it cannot be reassembled again"
Latour (2005), p. 250

5.1 Introduction

Chapters Three and Four of this study traced and assembled how the NCS-FET Life Sciences Policy is constructed and translated in practice as it circulates across the DoE, schools and industry nodes. This chapter provides a cross-nodal overview of the findings to answer the second research question posed in this study: *Is there an interface in terms of policy construction and SKAV development across the nodes, and if so, what is the nature of the interface?*

This overview is a (re)assemblage of what was assembled in Chapter 4. Particular emphasis is placed on the theoretical challenge posed by the theoretical framework (ANT, Latour, 2005) used in tracing and stabilising networks in order to map the interface(s) established across the three nodes of the study. As mentioned previously (in Chapter One), the interface is construed as a point of either convergence or divergence among the three nodes of the study, as reflected in Figure V below. Furthermore, the notion of the emergent effects of curriculum policy reform, as it applies to the tracing and stabilising of networks, is brought to bear.

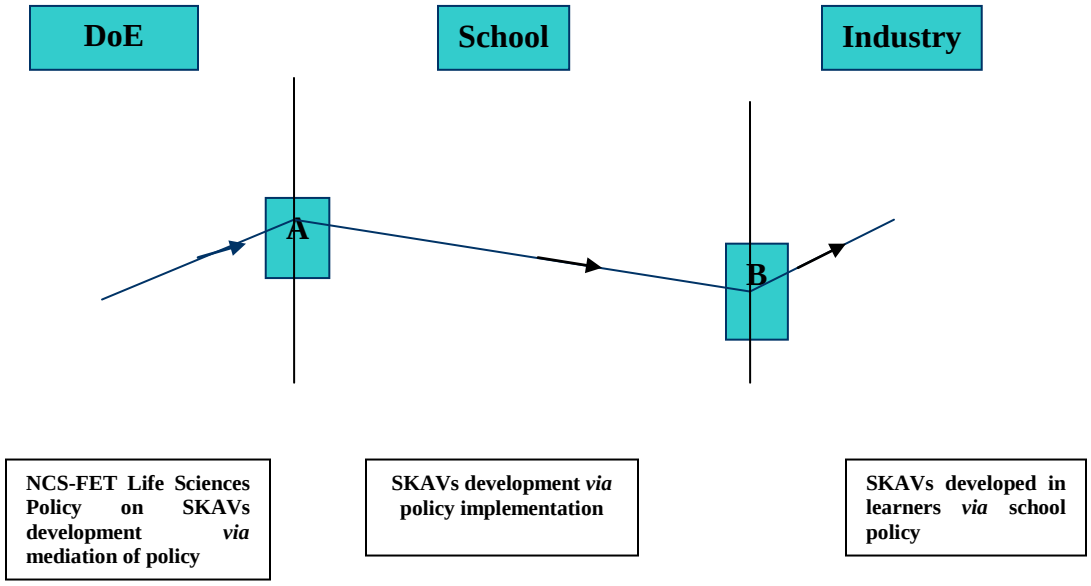


Figure V: Points of interface

To engage in the mapping of interface(s), I draw from the discipline of physics for our understanding of the use of the metaphor of an interface in this study. I use the metaphor of light travelling through three different media to illuminate how the NCS-FET Life Sciences Policy gets refracted at the interface(s). To map the interface(s) between the DoE, schools and industry node, the light beam is equated to policy (NCS-FET Life Sciences) of SKAV development, while the DoE, schools and industry nodes are equated to the media with different optical densities. In physics the optical density of a medium determines the extent to which the light beam travelling through it gets refracted. This means that the optical density of the medium contributes to the deviation of the light beam from its intended path**.** Therefore, the optical density of the node projects the emergent ray at the point of interface.

The discussion that follows will focus on the interface(s) established as well as the nature of the interface(s). The chapter is organised into four sections: The first focuses on the nodal overview of policy construction and SKAV constitution; section two unveils the nature of the interface(s); and section three depicts the emergent effects of curriculum

policy reform, concluding by signalling that there is much more going on in curriculum policy formulation and implementation than resources and teachers' capacity. Section four shows the reflections of the enquirer in using ANT as a theoretical framework and methodology.

5.2 Is there an interface?

The findings and analysis in response to the above question are presented at two levels - policy construction and SKAV constitution.

5.2.1 Nodal overview of policy construction

The analysis of the (re)assemblage of the networks from the nodal level reveals that there is an interface in terms of policy construction at a cross nodal level as reflected in the Figure VI on page 126. The key to the figure indicates the points of convergence and points of divergence in respect of the construction of policy at the points of convergences. Points 1- 4 represent the interface(s), while points 5-6 show the points of divergence with regard to the construction of policy. In terms of the construction of policy, there are no divergences at the industry node.

Key:

- 1 = DoE-schools interface: Policy construction as premature versus policy construction as experimental; policy as a hindrance
- 2 = DoE-industry interface: Policy construction as superior versus policy construction as a building block; policy as a hindrance
- 3 = School-industry interface: Policy construction as a hindrance
- 4 = DoE-school-industry interface: Policy construction as a hindrance
- 5 = DoE - construction of policy as superior and endangered
- 6 = School - construction of policy as an alien invader and as a game

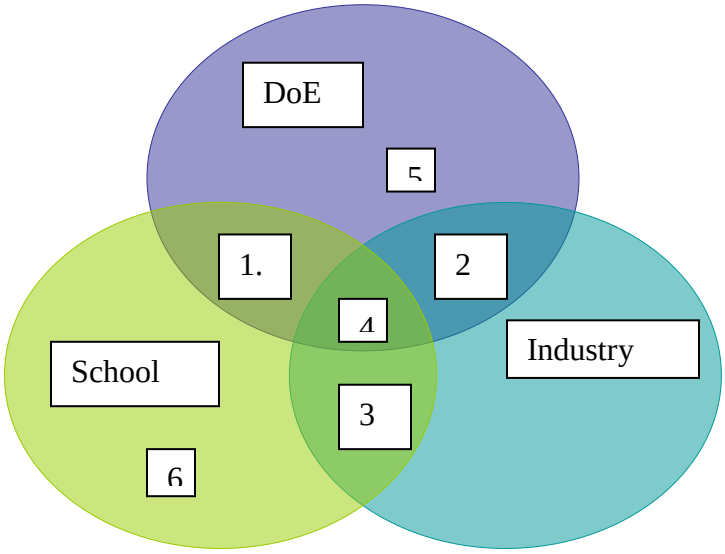


Figure VI: Interface in terms of policy construction

The interface(s) in respect of the construction of policy can be mapped in the four possible combinations, viz. DoE-schools level, DoE-industry level, schools-industry level and DoE-schools-industry level.

5.2.1.1 DoE-schools interface

At the DoE-schools interface the construction of policy as endangered, experimental, mutating and endangered negates the NCS-FET Life Sciences Policy in terms of the policy's goals and intentions in respect of broadening access to science, its curricular content and AS. At these two nodes goal oriented practices emerge therefore alliances are formed with good NSC exam results to produce good results that are associated with best

practice., The alliance formed with the NSC exams in these constructions of policy subvert or divert the policy from its intended transformatory path (see Figures II and III, Chapter Four).

5.2.1.2 DoE-industry interface

The DoE-industry interface affirms the NCS-FET Life Sciences Policy with regard to its curricula content when policy is portrayed as superior and as a building block for workplace learning. This affirmation leads to convergences in the network of policy construction. In a way this interface alludes to schools doing the bidding of industry in terms of SKAV development.

5.2.1.3 Schools-industry interface

The schools-industry interface illuminates the construction of policy as a hindrance in terms of its difficult, lengthy content and lack of SKAV for employability (see Chapter Four).

5.2.2 DoE-schools -industry interface

The DoE-schools-industry interface reveals that policy is constructed as a hindrance across all three nodes. The construction of policy as a hindrance annuls the policy and leads to subversion of policy in respect of assessment and curricula content. In the construction of policy as hindrance, alliances are formed with exams at each node. Exams flourish in each nodal network due to their association with different actors at the nodes (see Figures II, III and IV, Chapter Four). In an implicit way, exams reaffirm the curricula content of the policy.

5.2.3 Nodal overview of SKAV constitution

The analysis of the re-assemblage of the networks from the nodal level reveals that there is an interface(s) in terms of SKAV development at a cross-nodal level, as reflected in Figure VII on page 130. The key to the figure indicate the interface(s) in terms of SKAV constitution at the points of convergence and divergence. Points 1- 4 represent the interface(s), while points 5-6 show the points of divergence in respect of SKAV constituted. There is no point of divergence at the DoE node, as the SKAV constituted here interface with the SKAV constituted at the schools and industry node.

Key:

- 1= DoE-schools interface: hypothesis testing, terminology, identification of trends and translation of data
- 2 = DoE-industry interface: knowledge proficiency, identification
- 3 = Schools-industry interface: investigates; follows instructions; manipulate apparatus, presentations, compare, access information, group work
- 4 = DoE-schools-industry interface: knowledge proficiency, identification
- 5 = Schools: demonstrate, observe, record, application, interpretation
- 6 = Industry: recognise technical problems in apparatus, calculate ration, safe handling of materials, maintain sock register, maintain clean and tidy work station, mental alertness, work standard, ability to cope with stress, maturity, leadership, ethical skills, dependability, leadership, listening skills, telephone etiquette, make rational decisions, social responsibility to team, questioning skills, problem solving, reading scales.

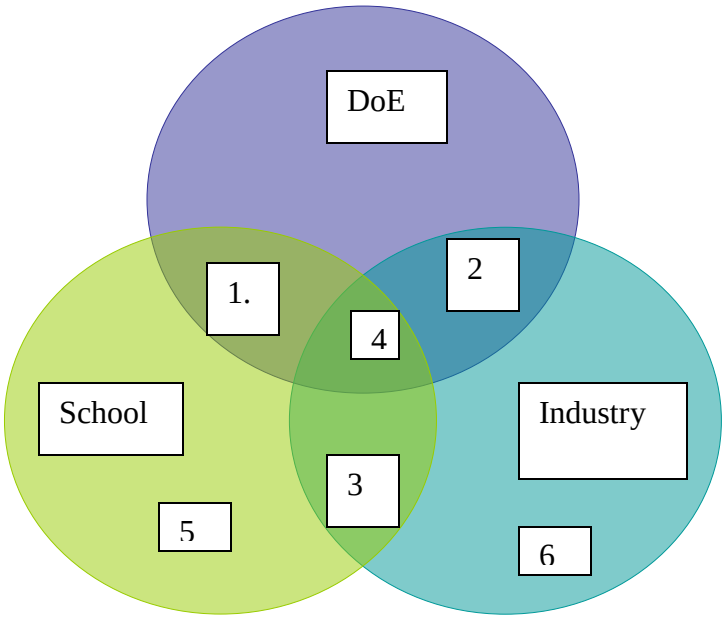


Figure VI1: Interface in terms of SKAV constitution

The diverse SKAV agendas of the different actors come to the fore at the cross nodal level. These diverse agendas result in the interface(s) being mapped in the four possible combinations, viz. DoE-schools level, DoE-industry level, schools-industry level and DoE-schools-industry level.

5.2.3.1 DoE-schools interface

The points of convergences at the DoE–schools-industry interface is in respect of SKAV foregrounded during mediation of policy, and indicate that SKAV considered as desirable

for success in the NSC exams are replicated at the schools node. During mediation of policy the numbers of SKAV (as per the gazetted policy) enrolled in teachers is pared down (see Figure VII). The points of convergences at the DoE-schools interface occur in respect of three LO1 competencies and one LO2 competency depicted in the figure above. It is interesting to note the lack of convergence in terms of the development of LO3 competences at the DoE-schools interface.

This particular finding highlights the total disregard for inclusion of IKS, environmental and societal issues in the gazetted policy during its mediation (see Chapter Four: DoE node - the NCS-FET Life Sciences Policy is considered as superior as it foregrounds IKS). Mediation and implementation of policy gets derailed by the NSC exams. The NSC exams mobilise and translate mediation and implementation of policy. The mobilising power of the NSC exams come to the fore and its influence on the DoE-schools interface in respect of SKAV development surfaces, since both practices foreground the SKAV that are testable in the NSC exams. The (re)assemblage reveals that action is not transparent, it has to be traced.

5.2.3.2 DoE-industry interface

There is a miniscule DoE-schools-industry interface in terms of SKAV development that occurs during mediation of policy. The points of convergence at the DoE-industry interface are in respect of identification and terminology related to LO1 and LO2 respectively. The DoE-industry interface has no points of convergences in respect of LO3.

5.2.3.3 Schools-industry interface

There are more points of convergences at the schools-industry interface than the DoE-industry interface. The points of convergences are in respect of LO1, LO2 and LO3 competencies, as illustrated in Figure VII. The schools-industry interface in terms of SKAV development draws our attention to the contested roles of schools in preparing

learners for the world of work. It also highlights industries' demand for SKAV for employability in the NTEW coming from school. What is particularly interesting to note from the data is that much of the emphasis placed on hypothesis testing seems misplaced in this particular industry's SKAV requirements. This finding debunks the myth that only high skills and high knowledge are required in industry.

5.2.3.4 DoE-schools–industry interface

The points of convergence at the DoE-schools-industry interface are in respect of identification and terminology related to LO1 and LO2. The DoE-school-industry interface has no points of convergences in respect of LO3.

The above findings indicate that there is an interface in respect of policy construction and SKAV constitution across the nodes. The interface alerts us to the interconnectedness and divergences between the espoused (gazetted) policy; its mediation and implementation are outcomes of the alliances formed at a nodal level.

5.3 The nature of the interface

The interface arises out of heterogeneous associations which alter the composition of each node. This means that the nature of the interface is characterised by the associations among actors, their actions, translations, and the points of convergences and divergences in the network. The more ties a f(actor) has in a network, the stronger is its alliance in the network. F(actors) with few ties in a network form fewer alliances in the network. The (f)actors that alter the composition of each node are illustrated in Figure VIII below:

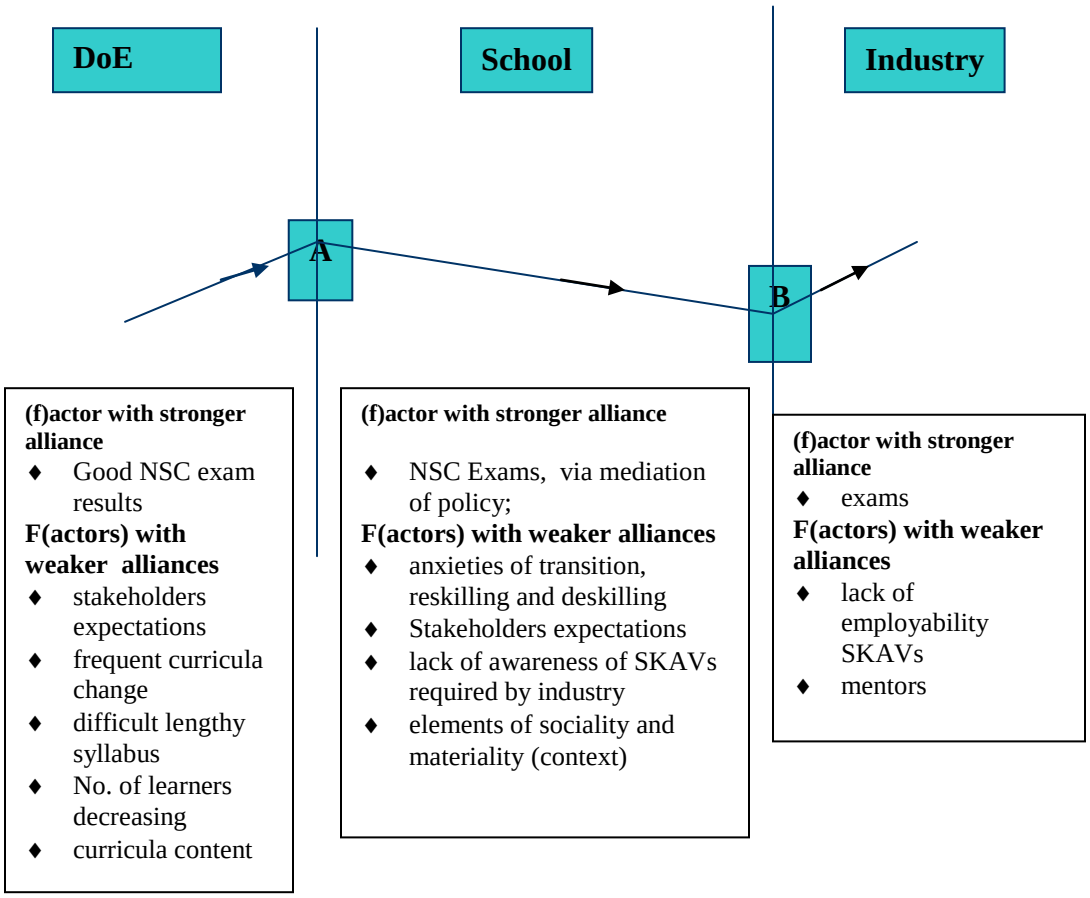


Figure VIII: Interface in terms of (f)actors with strong and weak alliances

The nature of the interface is dynamic; it evolves out of shifting associations among heterogeneous elements such as the NCS-FET Life Sciences Policy, subject advisors, NSC exam results, IQMS, fundraising, sport, teachers, microscopes, specimens, models, apparatus, education officers, learners, and NTEW (see Figures II - IV, Chapter Four). These associations are tenuous and in a perpetual state of becoming renewed due to the mobilisation, translation or dislocation they encounter within the network of policy construction and SKAV development. The shifting ties among the associations signal the unpredictability of these associations or the alliances they form. This means that the shifting ties point to the fluidity of the associations. In this regard, the actor network illuminates that the network undergoes metamorphosis in unpredictable ways. Therefore, the interface cannot be considered as something arising out of a linear relationship. It

emerges as part of an interactive network that is in a state of translation. The interface illuminates policy as an emergent effect of an actor network.

The cross-nodal (re)assemblage illustrates how networks in multi-sited research, while maintaining themselves at a nodal level, are interrelated across their nodes or boundaries (see Figure VIII: exams feature at each node). The (re)assemblage shows how action in one network can influence the conditions of networks in another site (node). The cross-nodal (re)assemblage indicates how alliance network(s) traverse(s) the nodes and become the starting-point for the new network at the next node.

The multiple coalitions with good NSC exam results at the DoE node are powerful and durable. They mobilise and translate mediation of policy into a dress rehearsal for the NSC exams. Alliances are also formed with teachers and good NSC exam results in the construction of their pedagogical identity to motivate them to produce good NSC exam results. It is interesting to note that the synergised alliance formed with good NSC exam results at the DoE node restructures itself and emerges as an exam alliance at the schools and industry node. The network changes according to the inner dynamics with the schools and industry node. This means that the nodes select (much like natural selection in an ecosystem) how the alliance network proliferating it must evolve or adapt to its internal environmental dynamics. This means that the good NSC exam results alliance network initiated at the DoE node comes under adaptive pressure at the schools and industry node. In other words, the alliance network evolves in response to actors' needs, associations formed, conflicts and negotiations at a nodal level. The evolving nature of alliance networks emerges at cross-nodal level.

The above discussion on (re)assemblage of networks traced captures the "interiority" of each node, and at cross-nodal level it reflects the interface and the actor network of this study. It brings to bear the divergent and convergent constructions of policy, f(actors) that alter the "optical density" of each node, and how practice gets performed and SKAV constituted in practice. The (re)assemblage at cross-nodal level reveals the interface(s) and actor network of this study. In the (re)assemblage we never venture outside the local

network. Thus the interface(s) is what lies within the network. The interface(s) cast curriculum policy as an emergent effect of heterogeneity within a network.

5.4 Unveiling the emergent effects of curriculum policy reform

This section discusses the following:

- The emergent effects of curriculum policy reform illustrate that policy reform is a complex, networked process. In other words it is a "*bricolage*" (Barrette,1998, p. 615).
- The emergent effect of curriculum policy reform has pointed to the slippage between what was intended (via the gazetted policy) and what was actually experienced in practice.
- Curriculum policy reform as an emergent effect shows that instead of the heroic performance of one human actor, multiple actors gyrate in the network, performing multiple routines in relation to materials. Thus thinking of curriculum policy reform as emergent has provided for the making of complex accounts of the ways in which socio-material elements negotiate their participation in policy reform. In other words, curriculum policy reform does not occur in isolation.
- Curriculum policy as an emergent effect exposes the gaps in the policy formulation process. The emergent effect of curriculum policy illuminates the distributive and extensive negotiations that go into the making of any curriculum, and the complexity of achieving a curriculum network comes into view.

The above insights are discussed at length in the following section.

5.4.1 Curiculum policy reform as *bricolage*

The emergent effects of curriculum policy reform illustrate that it is a *bricolage* (Barrette, 1998). The term *bricolage* is of French origin and entails the art of using materials at hand to create something unique (Barrette, 1998). In light of the above, curriculum policy reform is a complex, networked process involving many actors. Therefore, curriculum policy reform invokes the metaphor of a dynamic ecosystem to account for the interconnection, convergences and discontinuities that sculpt it (Heath, 2000). The dynamic ecosystem metaphor helps us to conceptualise the curriculum policy reform process as being complex, networked and involving elements of sociality and materiality (as can be seen in Figures II, III and IV of Chapter Four). This means that humans are not entirely in control of practice (Harris & Marsh, 2005). Thus, from an ANT perspective curriculum policy change is a matter of practice co-performed by sociality and materiality, that are interwoven and entangled in practice (Mulchay, 2007). Together sociality and materiality highlight how practice gets performed in a dynamic ecosystem. ANT is a useful tool for showing the negotiations that characterise patterns of curriculum policy change in terms of how practice gets performed and SKAV gets constituted in practice. The metaphor of a dynamic ecosystem explores the curriculum policy reform process from a Life Sciences perspective. It brings new understanding and attention to overlooked aspects of the policy reform process.

I used the metaphor of a dynamic ecosystem to capture the fluidity and heterogeneity of the curriculum policy reform process (Heath, 2000). In Life Sciences, ecology is the study of the relationship between organisms and their environment. Each f(actor) in the ecosystem has an influence on another f(actor), and many complex dynamic inter-relationships among them are required to sustain the system. A policy's dynamic ecosystem works in a similar way. Put simply, this means a policy's dynamic ecosystem consists of the policy along with all the socio-material elements it encounters as it traverses across the nodes of the study. Therefore, the metaphor of a dynamic ecosystem makes apparent the lack of continuity in the curriculum policy reform process.

The metaphor of a dynamic ecosystem brings to the fore the gaps, disjuncture or missing link between policy formulation and implementation, viz. mediation of policy as captured in Figures VI and VII of this chapter. As an analytical tool, ANT has offered us a unique way of understanding mediation. Mediation is perceived as an intervention offered by actors to bring about enrolment, enactment and translation in a network (Latour, 2005). This means that mediation of policy entails the diffusion of curriculum policy from its formulation (gazetted form) to its implementation. Like diffusion, which is an ongoing process that occurs until equilibrium is reached, ANT perceives mediation as an ongoing process that will result in the gazetted policy being espoused in practice. Therefore, mediation, from an ANT perspective, is not constructed as a rapid, one-shot intervention offered to practicing teachers. Rather, it is visualised as a link that bridges the divide between policy formulation and implementation.

During mediation of policy the gazetted policy evolves in terms of the SKAV foregrounded and policy construction at the DoE and schools node (as is visible from Figures VI and VII). The lack of attention to the mediation process by the National DoE results in contradictory agendas surfacing during mediation in terms of SKAV valued, policy goals, teaching approach, pedagogical identity of teachers and image of learners (refer to Chapter Four, section 4.2.1.1). These contradictory agendas get cascaded into implementation of policy. The refraction, so to speak, of the gazetted policy's transformatory and reconstructive agenda occurs during mediation of policy; mediation of policy initiates the deviation of the gazetted policy from its intended path of circulation.

5.4.2 Espoused policy slippage *vis-à-vis* enacted policy

The emergent effect of curriculum reform has pointed to the slippage between the espoused policy (Argyris & Schon, 1996), i.e. what was intended (via the gazetted policy) and the enacted policy, i.e. what was actually experienced in practice. This slippage occurs at two levels:

Level 1 - the divergent ways in which SKAV are valued; and

Level 2 - how practice gets performed.

These will be discussed briefly below. I first focus on SKAV valued and then on practice.

The divergent ways in which SKAV are valued allude to the different agendas among the actors in respect of the competencies they consider crucial for their practice and the survival of their practice. Underneath the high level of agreement between the DoE and DoL about the integration of education and training policies, lurks continuous tension about the details of this integration in practice (refer to Part B of Chapter Two, section 2.2.1). Serious weaknesses remain in the capacity of the DoE to implement its policy version.

The gazetted policy has a transformative and reconstructive human resources development agenda attached to it. The SKAV advocated in the policy are construed as being crucial for addressing the backlog in human resources development and overcoming the skills shortage in South Africa (DoE, 2003). When the gazetted policy interacts with actors during mediation and implementation of policy, the focus is on competencies that are testable in the NSC exams. The discussion in Chapter Four sections 4.2.1.4 and 4.2.2.4 pertaining to the DoE and schools nodes illuminates the competencies testable in the NSC exams. The competencies that are testable in the NSC exams get foregrounded while the transformative and reconstructive human resources development agenda is relegated to the background.

This has serious implications for how education can be used as leverage for human resources development and overcoming the skills shortage in South Africa. An arbitrary association between good NSC exam results and the attainment of the transformatory agenda attached to policy is perpetuated during mediation of policy (refer to Chapter Four, section 4.2.1.1 for a discussion on policy as premature and powerful). In reality, the preoccupation with good NSC exam results and competencies testable in the NSC exams refracts the policy's goal of redress in terms of human resources development, teaching

approach and kind of learner emerging from the FET band. Foregrounding competencies testable in the NSC exams raises the notion of whether mastery of certain exam-related competencies leads to the development of critical thinking and the promotion of high knowledge and skills, as envisaged in the NCS-FET Life Sciences Policy.

Actors at the industry node are demanding SKAV for employability in the NTEW emerging from schools. This is based on an econometric understanding of what constitutes valuable SKAV in an evolving labour market. The workforce of the future will need a whole spectrum of competencies to deal with technology and the globalisation of knowledge (Malcolm, 1999; refer to Part B of Chapter Two, section 2.2.3 for further discussion). Industry itself will also need to be flexible to adjust to continuous change in the competencies needed.

Each actor in the network of SKAV development has its own agenda in terms of the competencies they consider as valuable and beneficial to them, their practice and the survival of their practice. These agendas are contrary to the transformatory and reconstructive agenda of the gazetted policy. The gazetted policy foregrounds the development of high knowledge, high skills and critical thinking in order to address the human resources agenda and overcome the skills shortage. These contrary agendas are sculpted by the heterogeneous elements, their associations, negotiations, acts of persuasion and alliances formed with the conspicuous actor responsible for a particular practice (refer to Chapter Four, sections 4.2.4.1 and 4.2.4.2 for discussion).

It emerges via the actor network that these agendas are not reconcilable. For education to be used as leverage for human resources development, this study is unequivocal in alluding to a relational approach to SKAV development across the nodes of the study. A relational approach allows for education to be used as leverage in human resources development. This premise will only be possible if each actor in the network plays their role towards this common goal.

The implication of a relational approach is that the process of SKAV development aimed at addressing the backlog in human resources development and overcome the skills shortage cannot be confined and relegated to the schools node. The findings of this study lead to the notion of partnership formation at the three nodes of the study - DoE-Schools–industry - to facilitate the reform being advocated and reconcile the divergent agendas in respect of the development of competencies.

The forging of a partnership between the stakeholders is construed as essential to promote human resource development. Having local industrialists design resource materials for curriculum development is worth exploring in South Africa (see Part B of Chapter Two, sections 2.2.3 and 2.2.4). It could aid in facilitating SKAV development as a collaborative venture. At the other end of the spectrum is the need to develop a system that provides opportunities for life-long learning, to help individuals to adapt to evolving economic and societal change (Baptiste, 2001).

The second level of slippage occurs between the practice espoused in the gazetted policy and the practice enacted. As noted earlier (section 5.2), a network is created between the construction of policy, the optical density of the node, how practice gets performed and SKAV constituted in practice. The gazetted policy espouses that teachers should be developers of curricula material at a local level and not just implementers of policy (refer to Part B of Chapter Two, section 2.2.5). Teachers are expected to embrace innovative constructivist teaching approaches in their classrooms in order to promote the development of critical thinking and problem solving. It is envisaged that such teaching approaches will allow learners emerging from the FET band to have access to good-quality education, demonstrate an ability to think logically, analytically, holistically, and laterally, and be able to transfer skills from familiar to unfamiliar situations (DoE, 2003).

In reality, practice gets performed as negotiable moments at the DoE node, and as a juggling act in a dynamic ecosystem at the schools node. The deviation from the practice espoused in the gazetted policy is inextricably linked to the heterogeneous f(actors) that invades the DoE node during mediation of policy and the schools node during

implementation of policy. The heterogeneous f(actors) and their associations create varying agendas that dominate the mediation and implementation of policy, so that the gazetted policy's espoused vision for practice is ignored. These differing agendas were discussed in the section on the divergent ways in which SKAV are valued.

Curriculum policy as an emergent effect has shown that curriculum practice and policy reform remains a political, symbolic gesture when the espoused policy (gazetted policy) interfaces with the enacted policy. The espoused policy marks the shift from apartheid to post-apartheid society on paper - but in practice there is a lack of attention to understanding factors that undermine policy change (Jansen, 1999). The superficial, ritualistic adoption of policies since democracy allows DoE officials to project "formal accountability" for policy formulation, without allowing for substantial change in practice. The espoused policy appears to improve "educational conditions" in South Africa, but in reality practice has shown that nothing has changed. Access to sciences remains a problem, and exams continue to be a social control mechanism (refer to Chapter Four, section 4.2.1.1: DoE node policy construction as endangered and a hindrance, and section 4.2.2.1: School nodes policy construction as a hindrance). The emergent effect of policy has shown that practice does not give expression to the gazetted policy.

The actor network established in this study divulges that the gazetted policy becomes obscure and its authority gets weakened during the mediation of policy (refer to Table 2 in Part B of Chapter Two). It becomes apparent how the State and the DoE made use of their legislative power and missed the opportunity of embracing the mediation and implementation of policy into the policy formulation process. What emerges *via* the actor network is the power of the enrolled actors, such as good NSC exam results, in disregarding or disputing the mandatory gazetted NCS-FET Life Sciences Policy. Furthermore, it highlights the emergence of contradictory cartographies in the DoE's vision for policy reform.

5.4.3 Heroic performance of a human actor *vis-à-vis* multiple actors

Curriculum policy as an emergent effect shows that instead of the heroic performance of one human actor, multiple actors gyrate in the network, performing multiple routines in relation to materials. ANT's orientation to the principle of general symmetry suspends the dichotomy between object and subject (Latour, 2005). By granting agency to both human and non-human actors, ANT dissolves the uncertainty of the nature of objects (Latour, 2005). Only when we remove the uncertainty of the nature of the object are we able to illuminate, firstly, who the actors are in the phenomenon being explored, and secondly, the ties among the actors in the network (Latour, 2005).

The emergent effects of curriculum policy reveal that the curriculum policy reform process is a dynamic ecosystem, with hidden actors that are not conventionally considered in curriculum theory and practice. The ecological perspective is important because it infers that the motivation for action may not always be initiated from the human side of the network. As Latour (1992, p. 192) puts it, "purposeful action and intentionality may not be properties of objects but they are not properties of humans either, they are the properties of institutions, of apparatus or of what Foucault calls dispotifs". In other words, action comprises what is accomplished by the associations formed with other actors.

These associations, once traced, expose the "interiority" of the network (Latour, 2005, p. 217). For example, the construction of policy as an alien invader at the schools node (refer to Chapter Four, section 4.2.2.1 for discussion) and the performance of practice as a juggling act elucidate the heterogeneous elements such as fundraising, IQMS, PPN, administrative work, discipline and social welfare issues that compete with policy for time and space. These heterogeneous elements are not usually considered during curriculum theory and practice.

The emergent effect of curriculum policy reform exposes actors that acquire their form and attributes through their relations, connections and interactions with other actors. It is these associations that determine whether an actor becomes a mediator or remains an intermediary in the network. Mediators in a network shape how practice gets performed and which SKAV are constituted in practice. This means that curriculum policy reform involves more than the heroic performance of subject advisors and Life Sciences teachers at the DoE and schools node.

The emergent effect of policy has revealed that curriculum policy reform does not occur in isolation or in an insular way; that the context in which reform occurs is not a discrete or a separate entity. The context is not context *per se,* but a source of material, social and other actors that will participate in the co-construction of SKAV development (Latour, 2005).

The finding on policy construction as an alien invader - experimental, mutating and estranged - shows that actors are mutable and each transforms the other as they play out in practice, influencing the way in which policy emerges, evolves and is translated (Latour, 2005). Considering policy as an emergent effect brings to the fore the heterogeneous materials, which can move educational practice over space and time.

5.4.4 Gaps within the curriculum policy reform process

Curriculum policy as an emergent effect exposes the gaps in the curriculum policy formulation process. For example, the construction of policy as estranged and the findings of the preliminary survey make apparent the lack of teachers' and industrialists' participation in the curriculum policy reform process (refer to Chapter One, section 1.5). The emergent effect of curriculum policy reform illuminates the distributive and extensive negotiations that go into the making of any curriculum, and the complexity of achieving a curriculum network comes into view. Negotiation emerges as a means of survival for the actors within the network. Negotiations are a complex process between socio-material actors. They involve alliance formations, affirmation of policy, and

subversion of policy, convergences and divergences. As the gazetted policy traverses, it is modified in a series of negotiations during mediation and implementation of policy before it is adopted in practice, as depicted in the figure below.

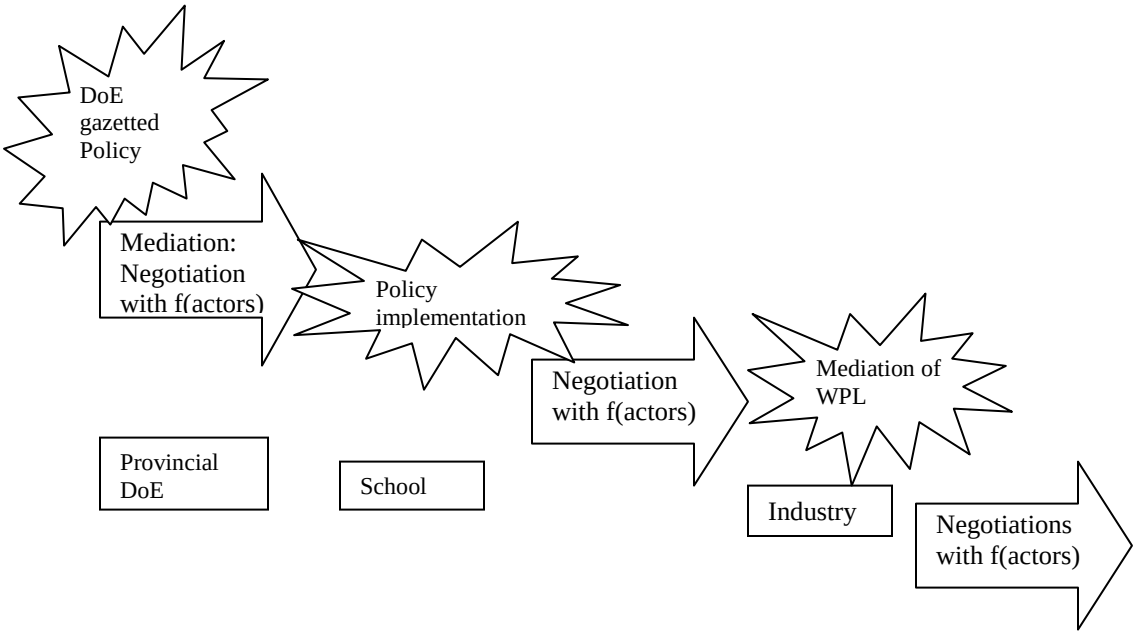


Figure IX: Negotiations occurring at each node

Each modification that occurs gives a new expression to the gazetted policy in terms of construction of policy and SKAV foregrounded. These negotiations are necessary for the survival of the actors' practice. For example, as already noted in Chapter Four, section 4.2.1, at the DoE node during mediation of policy the subject advisors form repeated coalitions with good NSC exam results. These alliances serve as a defence mechanism against the premature implementation of the policy, the decreasing number of learners pursuing Life Sciences, and stakeholders' criticism.

The emergent effects of policy highlight the associations that need to be strengthened to alter the nature of the interface and achieve the transformatory agenda attached to policy. They also highlight that in practice multiple pedagogical realities are performed imperfectly.

ANT emphasises the interconnectedness among actors in the network. The assemblage process has revealed that each node in this study is equivalent to a dynamic ecosystem. The dynamism is the outcome of associations, co-operations, competition, acts of persuasion and challenges that occur among the actors to ensure their survival. The practice occurring at each node is comparable to diffusion. The actor network indicates that the network undergoes metamorphosis in ways that are unpredictable. The gazetted policy is the Government's "script" for transformation via education. ANT has allowed us to conceptualise the curriculum policy reform as an innovative design process. The actor network demonstrates that the "script" is not enacted as envisaged. Its mediation and implementation gives way to competing agendas. This makes the gazetted policy a failure from a design standpoint.

5.4.5 Reflections on the use of ANT

In this study ANT has been used in unique ways to trace the trajectory of policy across multiple sites and to map the interfaces. Marcus (1995) maintains that multi-sited research is comparative in nature, and that the analysis is inherently fragmented by juxtapositions of the phenomenon that may have appeared to be worlds apart. Thus multi-sited research is confronted with dilemmas of depthlessness or absence of thick descriptions and the practical problems of working in diverse sites (Falzon, 2009).

The multi-sited research conducted in this study focused on unveiling the hidden, latent or invisible networks that are at work within each node (site) and across the nodes. I cross the theoretical underpinnings of ANT with the methodological implications of tracing over multiple sites. The phenomenon of the interface, which is drawn from the discipline of physics, has been incorporated with ANT's vocabulary to trace a moving target over multiple sites, assemble the traces, and reveal its emergence. The interface, which is a meeting point or point of convergence arising out of translations, reveals the continuities, discontinuities, convergences and divergences amongst entities within a node and across the different nodes. It elucidates what gets propagated into the next node, what is refracted or translated, what is responsible for the refraction, and which entities are mediators that mobilise practice.

Interface makes apparent the permeability of the media at the point of convergence, and shows emergent effects. The emergent ray that arises from the point of interface shows the emergent effects of the actor network. Emergence refers to the dynamic process arising from the shifting ties among heterogeneous elements. Interfaces allow for theorisation of findings in terms of optical density, emergence, continuities and discontinuities. It moves away from the idea that "everything is predefined", and maintains that "everything is evolving" from the heterogeneity of the network created by the actors. The phenomenon of interfaces in multi-sited research extends the analysis to the optical density of the node, performativity and "emergence".

5.5 Conclusion

The actor network of this study signals that there is much more going on in curriculum policy formulation and implementation than resources and teachers' capacity (Kraak, 2000; Chisholm, 2004). While studies conducted by scholars such as Kraak (2000) and Chisholm (2004) alert us to the resources (human, physical, financial) needed for curriculum implementation (refer to Part B of Chapter Two, section 2.2.1), the actor network established in this study points to the following factors: mediation of policy, good NSC exam results, IQMS, frequent curricula change, reskilling and de-skilling (refer to Chapter Four, section 4.2.1). These factors beg of us to (re)consider the role of materiality in the curriculum policy reform process, in order to make apparent the multiple actors - both human and non-human - that mobilise the curriculum policy reform process (Sorenson, 2007).

This study shows that materiality dominates the curriculum policy reform process. In other words, the curriculum policy reform process does not entail the heroic performance of resources (human, physical, financial). By thinking about curriculum policy reform in a relational way, room is created for other curriculum f(actors) to share centre stage. This means that all entities take their form and acquire their attributes as a consequence of their relations with other entities (Law, 1999).

Thinking of curriculum policy reform as emergent has provided for the making of complex accounts of the ways in which socio-material elements negotiate their participation in policy reform (Latour, 2005). In this way, ANT makes visible the work of all entities involved in shaping practice. Less dominant factors and multiple voices that present in multiple ways are not overlooked (Latour, 2005).

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List of Appendices

A ETHICAL REQUIREMENTS		
A1	Ethical Clearance	165
A2	Change in title	167
A3	Permission from DoE to conduct research	168
A4	Schedule showing duration of FET training session	169
A5	Permission from industry to conduct research	170
B PRELIMINARY SURVEY		
B1	Informed Consent letter industry	171
B2	Questionnaire-Industry	172
B3	Informed consent letter Life Sciences Teachers	174
B4	Questionnaire Life Science Teachers	174
B5	Informed consent letter Curriculum Developer	175
B6	Semi structure interview question- provincial curriculum developer	176
B7	Semi structure interview question- National curriculum developer	176
B8	Analysis of data Industry questionnaire	177
B9	Analysis of data teachers' questionnaire	179
B10	Transcripts of interview with provincial curriculum developer	183
B11	Transcripts of interview with national curriculum developer	184
B12	Semi structured interview question HR personnel	186
B13	Transcripts of interview with HR personnel	187
B14	Semi structured interview question NTEW	187
B15	Transcripts of interview with NTEW	188
B16	Transcripts of interview with NTEW	188
C. DEPARTMENT OF EDUCATION NODE		
C1	Informed consent letter Life Sciences mediator	189
C2	Exact SKAVs foregrounded in intended policy	190
C3	Transcript of observation of mediation	192
C4	Analysis of mediation of policy	201
C5	Elaboration of NCS-FET policy	203
D. SCHOOL NODE		
D1	Informed consent letter Life Sciences teacher- main study	211
D2	Anecdotal images enroute delivery of questionnaire	211
D3	Questionnaire Life Sciences teachers	218
D4	Analysis of questionnaire responses	218
D5	Observation OF LESSONS	221
D6	Questions for focus group interview	229
D7	Transcripts of Post observation focus group	229
D8	Analysis of observation and focus group interview	231

D9	Questions for conversation with SEM	236
D10	Transcript of interview with SEM	236

E. INDUSTRY NODE

E1	Semi structure interview questions for EO and mentors	238
E2	Comparative analysis of interview	238
E3	Observation schedule for SKAVs enactment	240
E4	Guideline questions for Snap Shot with NTEW	242
E5	Snap shot details	242
E6	Analysis	249

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10 DECEMBER 2007

MS. A PILLAY (200302484)
SCIENCE, MATHEMATICS & TECHNOLOGY EDUCATION

Dear Ms. Pillay

ETHICAL CLEARANCE APPROVAL NUMBER: HSS/0626/07D

I wish to confirm that ethical clearance has been granted for the following project:

"An exploration of the relationship between schools and industry provided learning with particular reference to the development of skills, knowledge, attitudes and values (SKAV's) in Biotechnology"

PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years

Yours faithfully

MS. PHUMELELE XIMBA
RESEARCH OFFICE

cc. Faculty Research Office (Derek Buchler)
cc. Supervisor (Dr. BP Alant)

04 December 2008

200302484
Ms. Asheena Singh- Pillay
PO Box 337
Verulam
4340

UNIVERSITY OF
KWAZULU-NATAL

Dear Ms. Asheena Singh- Pillay

Re: Change of Thesis Title – Asheena Singh- Pillay 200302484 -PhD

The Chair of the Faculty Higher Degrees Committee has executively approved your request to change the title of your PhD thesis from:

Old Title: An exploration of the interface between school and industry in respect of the development of Skills, Knowledge, Attitudes and Values (SKAVs) in the context of Biotechnology

to

New Title: An exploration of the interface between schools and industry with regard to the development of Skills, Knowledge, Attitudes and Values (SKAVs) in the context of Biotechnology

Thank you.

Karen Sallie (Ms)
Postgraduate Office

Tel: (033) 260 5449
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CC: Professor D. Bhana
CC: Dr B Aland

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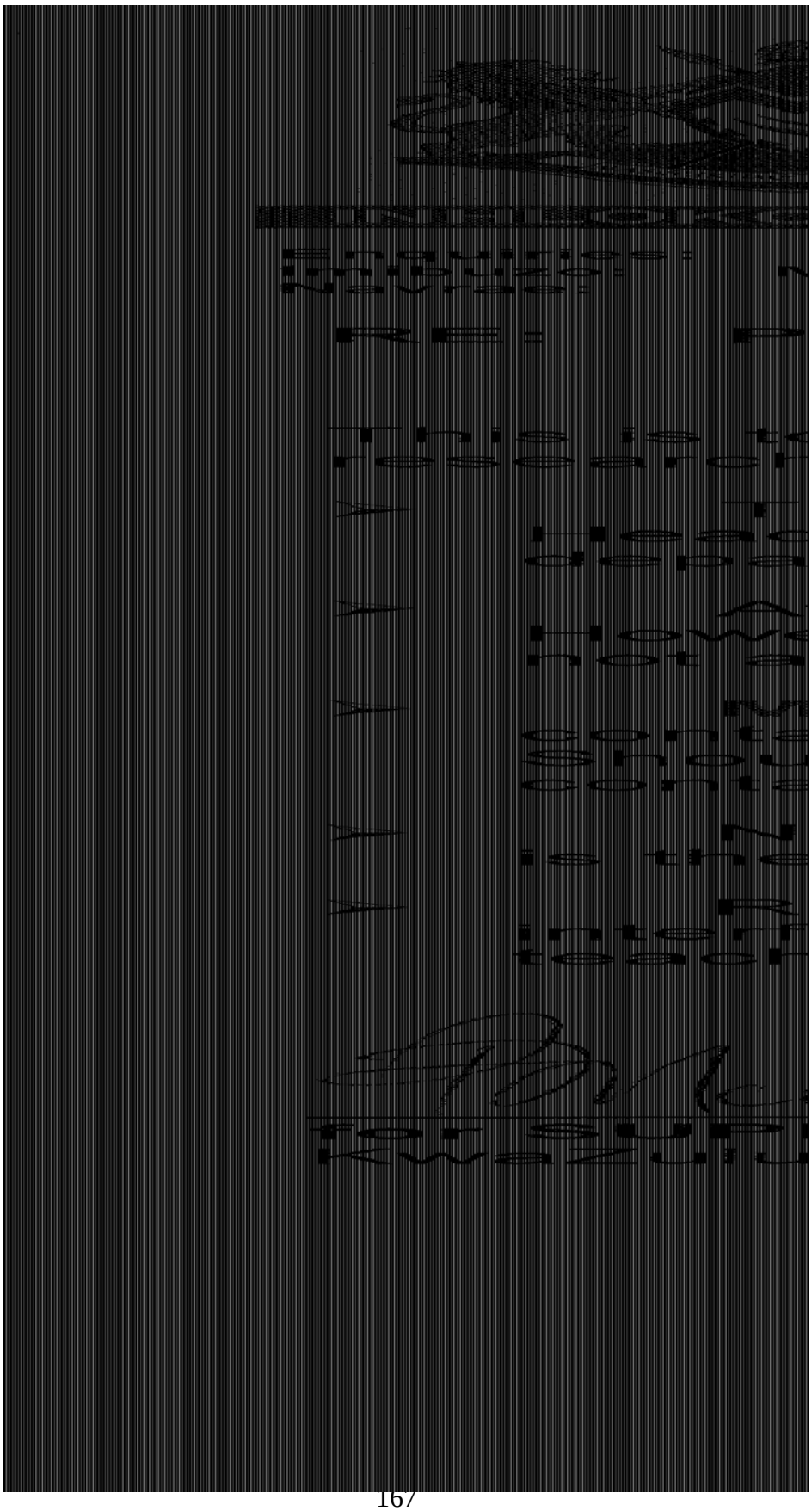


ORIENTATION FOR GRADE 11-12 EDUCATORS
ETHEKWINI REGION – SCHOOL HOLIDAYS

Circuit	KwaMashu		Phoenix		Umhlatuze	Phumelela		Durban Central	Chatsworth	
Venue	*K/Mashu Ed. Cntr.* *Phoenix Ed. Cntr.	*Sivananda Coll. (K/Mashu Campus)*	Phoenix Ed.Cntr.	*Stonebridge PS*	Dokkies	Ethekwini FET Coll. Swinton Campus	*Vukuzakhe HS*	Durban Ed. Cntr.	Chatsworth Ed. Cntr.	*Westpark Sc.*
26-30 June	IsiZulu/ Phys. Sc/ LO/	Acc	Life Sc	English/ B.Studies/ Geog	History/Math Econ/Math lit	History/Math Econ/Math lit		English/ Geog/ B.Studies/ Life Sc/ Afrik	IsiZulu/ Phys. Sc/ /Acc	LO
03-07 July	English B.Studies/ Life Sc/ *Tourism/ *Cons. St.	Geog	Tourism/ Cons.St.	History/Math Econ/Math lit	IsiZulu/ Phys. Sc/ LO/ Acc	IsiZulu/ Phys. Sc/ LO/Acc		History/Math Econ/Math lit	Life Sc/ Geog/Afrik	English / B.Studies
10-14 July	Econ/ Math	History	Phys. Sc/ LO	IsiZulu/ Acc	English/B.Stud Life Sc/ Geog		English/B.Stud Life Sc /Geog Afrik/	IsiZulu/Phys. Sc/Cons.St. LO/Acc	History Econ/	Maths

* Educators for the marked subjects will attend at the marked venues

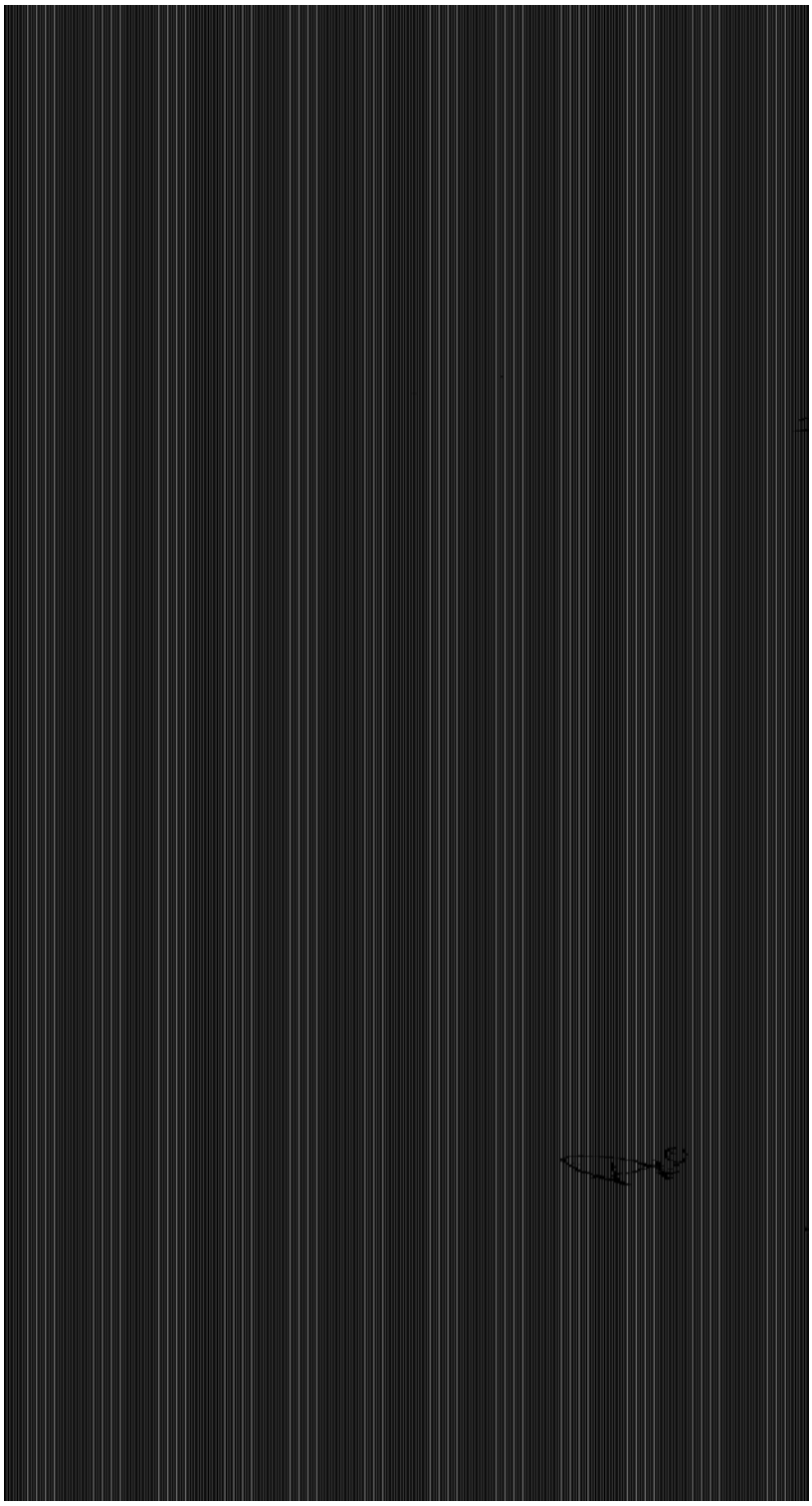
COMBINED CIRCUITS

DATE	SUBJECT	CIRCUITS	VENUE
26-30 June	Visual Arts Design	Umlazi District	*Durban Girls High*
26-30 June	Tourism/Cons. St.	Umhlathuze, Hammarsdale	Durban Ed. Cntr.
26-30 June	Afrikaans	KwaMashu,Phoenix	Phoenix Ed.Cntr.
26-30 June	Dramatic Arts	Umlazi District	*Westville Boys High*
26-30 June	Tourism/ Cons. St.	Lower Tugela	Stanger HS
03-07 Jul	Hospitality St.	Ethekwini Region	*KZN Coastal College-Mbumbulu Campus*
03-07 Jul	Dramatic Arts/Visual Arts/Design	Pinetown & Ilembe Districts	*KZN Coastal College-MbumbuluCampus*
03-07 Jul	Tourism Consumer St.	KwaMashu, Phoenix	Phoenix Ed. Cntr.
03-07 Jul	Afrikaans	Hammarsdale, Umhlathuze	*Gelofte HS*
10-14 Jul	Tourism Consumer St.	Phumelela,Umbumbulu Chatsworth	Chatsworth Ed. Cntr.
10-14 July	Dance Studies	Ethekwini Region	*Crawford College La Lucia*
10-14 July	Music	Ethekwini Region	*KZN Coastal College-Mbumbulu Campus*
10-14 July	Afrikaans	Phumelela, Umbumbulu	*KZN Coastal College-Mbumbulu Campus*

30 May 2006

1

PTO.



APPENDIX B
Annexure: B1

Consent form for preliminary survey in industry
Dear CEO/ HR Personnel/Education officer,
I am a PhD student, registered at UKZN. I am conducting a study that focuses on the ability of the school Life Sciences curriculum to provide learners with appropriate background for the world of work in the Biotechnology industry. In other words we are trying to see if there is a link between what is learnt in schools and what is needed in industry. In order to explore this interface between schools and industry with regard to Skills, knowledge, attitude and values (SKAVs) development I have identified 6 industries in the Phoenix North region that use the application of Biotechnology covered in the grade 10, 11 and 12 NCS-FET Life Sciences curriculum. I hereby seek your permission for your company to participate in my study. Please note that your participation in this study is voluntary. Should you decide to participate in this study you would be expected to complete a questionnaire that will take up 30 minutes of your time.

Researcher: Ash Singh- Pillay
Student No.200302484
Cell No. 0844303795

Promoter: Dr. B.P.Alant
School of Science, Mathematics and Technology
Faculty of Education
Tel.No. 031-2607606

Declaration
As a participant in this study I understand that:

- My participation is voluntary, I am not being forced to take part in this study
- I may withdraw from the study if necessary
- I may refuse to answer any questions on the questionnaire that requires information that is considered to be ”privileged” information
- Anonymity will be guaranteed at all times- my company name, logo or the names of my employees will not be revealed on any documents to be completed or in the study
- Confidentiality will be guaranteed at all times, information gathered will only be used for the purpose of this study the researcher will not make information gathered at this industry available to any other industry that uses the application of Biotechnology
- I_____ hereby confirm that I understand the contents of this document and the nature of this study. I consent to taking part in this study.

I understand that I am able to withdraw from the study at any time, should I wish to do so.

_____ _____
Signature **Date**

Annexure B2

PRELIMINARY SURVEY QUESTIONNAIRE: - INDUSTRY NODE

Kindly indicate the position of the personnel who will be answering this questionnaire and who will be liaising with the researcher

CEO ☐

HR Personnel ☐

Education Officer ☐

Questionnaire:

1. Does your company employ individuals who have no tertiary education/qualifications?

_____

_____

2How many employee's in your company do not have a tertiary education?_____

_____

3.In what capacity are these non tertiary educated employees employed i.e. are they doing menial tasks or are they involved with the application of Biotechnology used by your industry?_____

_____

_____

4. If there are non tertiary educated individuals involved with the technology used in your company, did they need to have certain subjects/ skills to be employed in this section of your company? (please elaborate)_____

_____

_____

_____

_____

5. Does your company assist these non tertiary educated employees involved with the technology used in your company, to improve their qualifications?(If yes please specify)

_____

_____

_____

_____

6.1. How many employees in your company do not have tertiary education? (Please be specific)_____

6.2.1. How many of these non tertiary educated worker have jobs that involve the application of Biotechnology in your company?_____

6.2.2. How many non tertiary educated worker have other jobs- menial jobs etc?

_____

6.3. What level of education, i.e. schooling, did these employees mentioned in 6.2.1. above need to have to be employed in their current jobs?_____

_____

6.4. What level of schooling did the other non tertiary educated employees, i.e. those employed in menial tasks, need to have to be employed in their current jobs?_____

_____

_____

7.1. With regard to non tertiary educated employees involved in the application of Biotechnology how many of these employees are males and how many are females? (please try to be

specific)_____
_____
_____
_____

7.2. Does your company have a /any policy put into place/ practice when it comes to employment with regard to gender?(please
elaborate)_____
_____
_____

7.3. Does your company have a/any policy put into place/ practice when it comes to employment with regards to race?(please try and
elaborate)_____
_____
_____

7.4. What is the average age range of the non tertiary educated employees involved in the application of Biotechnology at your company?(please
elaborate)_____
_____

7.5. Do you/ your company have a preference for any particular age group when it comes to recruitment of employees?(please
explain)_____
_____

Kindly, tick the appropriate block below, to indicate whether your company is willing to participate in the main study.

Yes ☐

No ☐

Annexure B3

Consent form – Preliminary survey:
Life sciences educator

Dear Life Sciences colleague,

I am Ash Singh-Pillay a fellow Life Sciences educator and a PhD student, registered at UKZN. I am currently engaging in research that explores the relationship/interface between schools and industry provided learning with particular reference to the development of skills, knowledge, attitudes and values (SKAVs) in Biotechnology. In order to conduct the above mentioned study I fist need to conduct a survey on the kinds of partnerships between schools, subject advisors and industry and how these partnerships impact on the implementation of the NCS-FET Life Sciences curriculum in your classroom. I hereby seek your consent to participate in my study by answering a questionnaire. This will take at least 20 minutes of your time. You have been randomly selected from the pool of Life Sciences educators in the Phoenix North Region. Please note that your participation is voluntary. I assure you of total confidentiality and anonymity as you will not be required to write your names on the questionnaire and the results of this finding will only be used for the purpose of my study.

Researcher: Ash Singh-Pillay
Student No.200302484
Cell No. 0844303795

Promoter: Dr. B.P.Alant
School of Science, Mathematics and Technology
Faculty of Education
Tel.No. 031-2607606

Declaration

As a participant in this study I understand that:

- My participation is voluntary, I am not being forced to take part in this study
- I may withdraw from the study if necessary
- I may refuse to answer any questions in the questionnaire that requires "privileged" information
- Anonymity will be guaranteed at all times- I will not be required to reveal my name on the questionnaire
- Confidentiality will be guaranteed at all times, my responses will not be reported to my school, subject advisors or department officials
- I_____ hereby confirm that I understand the contents of this document and the nature of this study. I consent to taking part in this study.

I understand that I am able to withdraw from the study at any time, should I wish to do so.

_____ _____

Signature **Date**

Annexure B4

Preliminary survey Questionnaire Life Sciences educators
Part: A

1. Were you consulted about the NCS- FET Life Sciences curriculum with regard to SKAV's development?_____
2. The Life Sciences curriculum developers stated that the NCS- FET Life Sciences curriculum was posted on DoE's website for comments from interested stakeholders.
   Do you have access to internet facilities?_____
   Is this an effective way of communicating with you, the curriculum implementer in the classroom?_____
3. The NCS- FET Life Sciences curriculum refers to certain SKAVs used by Biotechnology industry e.g. baking industry, alcohol industry, canning industry, dairy industry, sugar industry, pharmaceutical industry. Is it necessary for you (i.e. the educator) to have partnerships with the above mentioned industries? Please explain your answer._____
   _____
4. Are you willing to forge these partnerships with these industries with regards to SKAVs development?_____
   _____
5. Is there a direct partnership with your school and any of the above mentioned industries with regard to curricular development (e.g. support materials, teacher training ect)?_____
6. Are there any indirect partnerships between your school and industry with regard to funding/ sponsorships etc? Please explain._____
7. Do these indirect partnerships with industry impact on the way in which the NCS- FET Life Sciences curriculum is implemented in your school? Please elaborate your answer._____
   _____
   _____

Part: B

8. How are the NCS- FET Life Sciences policy goals negotiated with parent by you/ your school?(please explain)_____
9. Are parents directly involved with curricular issues?_____
10.1. Do parents form partnerships with the school where they may teach a section they are qualified in or they may organise support material/training for educators from their place of work or they may arrange for excursions to an industry that is referred to in the curriculum?_____
_____
10.2. How are the NCS- FET Life Sciences policy goals negotiated with SGB/ Councillors/community leaders by you/ your school?(please explain)_____
_____
_____
10. 3. How are the NCS- FET Life Sciences policy goals negotiated with RCL/ learners by you/ your school?(please explain)_____
_____
_____

Part: C
11.1. How are the NCS- FET Life Sciences policy goals negotiated with you by Subject advisors?_____
11.2. What suggestions have you made about the NCS- FET Life Sciences curriculum/ policy goals or implementation?_____
_____

11.3. In what context are these suggestions made to subject advisors/curriculum developers?_____

12. Are the suggestion made by Life Sciences Educators taken seriously by subject advisors and are these suggestions having any impact on The NCS- FET Life Sciences curriculum with regard to content, depth, assessments etc?(please elaborate)

Annexure B5

Preliminary survey:
Consent form –Curriculum Developer

Dear Life Sciences colleague,

I am Ash Singh-Pillay a fellow Life Sciences educator and a PhD student, registered at UKZN. I am currently engaging in research that explores the relationship/interface between schools and industry provided learning with particular reference to the development of skills, knowledge, attitudes and values (SKAVs) in Biotechnology. In order to conduct the above mentioned study I fist need to conduct a survey on the kinds of partnerships between schools, DoE, subject advisors and industry and how these partnerships impact on negotiation and implementation of the NCS-FET Life Sciences curriculum in the classroom. I hereby seek your consent to participate in my study by answering questions posed to you during a semi structured interview. You have been purposively selected due to your involvement in the development of the NCS-FET Life Sciences curriculum. This interview will take at least 20 minutes of your time. Please note that your participation is voluntary. I assure you of total confidentiality and anonymity as you will not be required to reveal your name during the interview and pseudonyms will be used in the transcripts. I assure you that the results of this finding will only be used for the purpose of my study.

Researcher: Ash Singh- Pillay
Student No.200302484
Cell No. 0844303795

Promoter: Dr. B.P.Alant
School of Science, Mathematics and Technology
Faculty of Education
Tel.No. 031-2607606

Declaration

As a participant in this study I understand that:

- My participation is voluntary, I am not being forced to take part in this study
- I may withdraw from the study if necessary
- I may refuse to answer any questions during the interview that requires "privileged" information
- Anonymity will be guaranteed at all times- I will not be required to reveal my name during the interview nor will my name appear in the transcripts
- Confidentiality will be guaranteed at all times
- I_____ hereby confirm that I understand the contents of this document and the nature of this study. I consent to taking part in this study.

I understand that I am able to withdraw from the study at any time, should I wish to do so.

_____ _____

Signature **Date**

Annexure B6

Preliminary survey: Semi structured interview questions: provincial curriculum developer

1. Which individuals were involved with the development of the NCS -FET Life Sciences curriculum?
2. Did these curriculum developers consult/ contact/ invite teachers/industrialists/ other organisations to be involved with curriculum development with regard to content, SKAVs etc?
3. Is this an effective way of communicating in our country?
4. How are partnership negotiated with industries/ educators/ employees with regard to the SKAVs development and the goals of the NCS -FET Life Sciences curriculum?
5. Why were individuals from technikons and universities included in the panel and not industrialists?
6. Have any other efforts been made by curriculum developers to forge partnerships with industries/educators/ employees with regard to SKAVs development and the goals of the Life Sciences curriculum?

Annexure B7

Preliminary survey: Semi structured interview questions: National curriculum developer

1. Can you please take me through the process that was involved in the selection of curriculum developers? How were decisions taken/made and how were they carried through the process.
2. Explain the reasoning behind DoE's choice to have The NCS -FET Life Sciences curriculum posted on the DoE website for comments from the general public.
3. What was the response from the public like. What did you think of how the public responded? How do you plan to interact with the public in the future?
4. How was the process taken forward after the comments from the public were solicited?
5. Statistics from the HSRC (2004) show that only a small percentage of learners (17%) go to tertiary institutions in S.A. and that the vast majority have to enter the world of work. Did the National Department of Education ever consider that only a small majority of learners do in fact go tertiary institutions?

6. Is it hoped by DoE that eventually all learners from the FET band will go to tertiary institutions hence the inclusion of personnel from tertiary institutions on the panel?

7. I have conducted a survey of 6 industries in KZN that use the application of Biotechnology in the production of their products. These industries indicated that they have in their employment non tertiary educated personnel (i.e. personnel without tertiary qualifications) involved in the application of Biotechnology. This survey was done to explore the National Education Departments understanding of their role in establishing partnerships with other stakeholders other than working exclusively with tertiary institutions. I explored their role in terms of:

   a) Partnerships at a curriculum development level and
   b) Partnerships at a curriculum implementation level? This entails the following components:
   i. the other curriculum developers and :
   ii. subject advisors
   iii .educators
   iv. parents/ S.G.B's
   v. learners

The survey indicates that these 6 industries did not have a partnership with DoE at a curriculum development level. However these industries do have partnerships with schools in that geographical region at a sponsorship level- i.e. funding. At a curriculum implementation level curriculum developers and subject advisors trained educators for the implementations of the NCS -FET Life Sciences curriculum. At a school level partnership were established with parents/ SGB's and learners by the management and staff-this was done at information dissemination meetings. What are your comments on the above statements.

Annexure B8

Data analysis of questionnaire sent to industries

Data analysis for A1 and A2

Table showing total number of employees and the category of employee jobs
Q1, 2,3

Industry	**Total no of employees**	**No. with tertiary qualifications Involved in application of biotechnology**	**Non-tertiary involved in application of biotechnology**	**No. of male NTEW involved in application of biotechnology**	**No. of female NTEW involved in application of biotechnology**
A.	105	45	60	50	10
B.	110	20	90	70	20
C.	105	5	100	40	60
D.	75	5	70	45	25
E.	135	15	120	40	80
F.	310	60	250	120	130

Table: Q6.3&4

Ed. Qualification for Menial job				Ed. Qualification for Biotech job	
prim ed		sec	Skills	matric	
A.	√	√		matric	M +Bio compulsory, physics advantage
B.	√		read, write, speak	matric	science subject
C.	√	√		matric	biology and physics
D.	√	√		50 with matric, 20- gr.11 bio compulsory. sub. Physics adv.	
E.	√	√	communicate well	matric with biology	
F.	√	√		matric with bio, physics and maths	

Q5

Industry	A few of the entry-level skills for a biotechnology job
A.	Observe, control variables, oversee experiments, follow instructions
B.	Monitor experimental conditions- temperature/carbon dioxide level, follow instructions , Ph
C.	Take accurate readings/volume/temperature control, enzyme control, ph control
D.	Read /write/communicate well, take accurate readings, control temperature, group work, give instructions
E.	Measure correctly- set timer, control temperature, give instructions, check texture of dough/softness/volume/nutritional value, teamwork, follow instructions
F.	Listening skills, people skills, observation skills, measuring and identification of compounds

Table

industry	No. males in Biotech	No. females in Biotech	Age range
A.	50	10	19-40
B.	70	20	20-45
C.	40	60	18-50
D.	45	25	18-40
E.	40	80	18-50
F.	120	130	18-40

Table: Q7.2,7.3 &7.5

industry	Preferred age range for employment	Gender policy	Race policy
A	19-26- they learn faster	Yes-difficult to put in practice- fewer females applicants with matric+ science subjects	Yes-but depends on applications received, during short listing we ensure race equity- facts and figures confidential
B	20-25 minds sharper/learn easily during training/stay with company for longer period of time	Yes-not many applications received from females with needed requirements for biotech jobs	Yes- information on employee race classification confidential
C	18-25-younger workers remain with us for a longer time, they have fewer health problems and are absent lees frequently from work	Yes- our figures reflect gender equity- females are more committed to their jobs, give less problems when reprimanded, do not come drunk to work	Yes+\- 40% of staff black- further break down of figures on race of employees is confidential
D	18-25 –better investment for our company-they work harder and learn faster	Yes- it may not be what is expected but we are moving towards gender equity	Yes-most of our workers are blacks- i.e. Africans and Indians-cannot supply exact figures
E	18-22- they learn faster and remain with the company longer	Yes- we employ more females than males- we are an established food industry that receives more applications for jobs from females than males	Yes- just under 50% of staff are blacks. Exact stats confidential
F	18-24- they learn faster, are in a better condition of health/mind, are generally more conscious of their appearance and are an investment for our company/they can work for a longer period of time with us	Yes- our figures above reflect our gender equity policy. I find that women employees work hard, stay away less often, show empathy to customers, have better communications skills, take more pride in their personal appearance- we are a health care industry	Yes-its hard to comply with this policy in every pharmacy-it depends on the location of the pharmacy- those in white areas have fewer black employees as hours are long and transport is a problem. Those in central town have more black employees. There are many factors that influence putting this policy into practice. I cannot reveal exact figures on employee race but +/- 30% of our staff are black.

Annexure B9

Data analysis of questionnaire sent to Life Sciences educators

Q1	Q2.1	Q2.2
1.no	no	not effective way to communicate , I didn't know that the policy was on the net and that we were expect to comment on the policy. Surly a notice could be sent to schools telling us bout DoE's expectation or subject advisor could meet us to get our comments during regional meeting
2.no	yes	not at all, it's an added expense
3.no	no	no, its not affordable
4.no	no	I don't know how to use a computer
5.no	no- poor	no, can't use computer& no access to computer
6.no	no- too expensive.	most certainly not
7.no	no	I have no computer and no internet, I'm computer illiterate
8.no	no	never, cannot afford it
9.no	no	no, 40% of population lives below bread line
10.no	no	no –I'm computer illiterate, I don't know how to use a computer
11.no	no	no, cannot use computer
12.no	no	no
13.no	no	no- access issues in SA. S.A. not first world country
14.no	no	no- poverty, unemployment high most can't afford comp.
15no	no	no computer illiterate

Q3	Q4
yes, so we know what industry expects of us	no, department must do that
yes, it would help us to teach these sections	no, responsibility of curriculum developers.
no, curriculum developers must do that	no, it's the job of curriculum developers ,they get paid.
yes, it would benefit us & the learners	no, it's the job of subject advisors
yes, not trained in industrial process	yes, but I don't know how to start
yes, to aid us with teaching	no, it's the job of subject advisor & curriculum developers
no, curriculum developer must do that	no. subject advisor must do that
no, not my responsibility curriculum developer must earn their salary	no subject advisors &CD are too lazy
yes, to receive support materials	**yes, I don't know how to**
no, CD/SA must have links with them	no, not my job
no, job of subject advisors	no, not my job
no, I don't get paid to do this	no, Subject advisors must do this
no, CD/ Subject advisors must do that	no, I don't know where to begin
yes, help with teaching these sections	no, CD/ SA's must do that
no, not my job	no, CD/SA's must do that

- CD= Curriculum developers SA's = Subject advisors

Q5	Q6	Q7
no	yes, funds for physical maintenance, beg for sponsorship	yes, funds to buy resources

no	yes, paint company paints building use it for marketing	it's hard to tell- neat buildings keep enrolment up
no	yes, sporting equipment, initiated by parent	in a way, many codes of sport offered, learners more attentive in class
no	yes. Micro-kits for practs, started by ex-pupil	yes, can do demonstrations to show what I'm talking about-no lab in our school
no	yes, for feeding scheme- principal stated this	yes, children pay attention in class now they are not hungry
no	yes, physical maintenance-staff effort	not directly sch. Envir. More conducive to learning
no	yes, cctv to monitor behaviour, drug/violence staff effort	indirect way-learners don't abscond, better behaved
no	yes, school used as advert for companies	in a way, more money for teaching aids- hands on activities
no	yes, appliances for sale during fund raising- ex pupil effort	in a way-buy lab stock can do practs- hands on
no	yes, food for fund raising- parent effort	yes, money used to buy teaching aids to help us in the class
no	yes, paint for buildings	No
no	yes, physical up keep of building	I cannot say it does or does not
no	yes-good to sell & raise funds	definitely, teaching resources purchased -impacts on curriculum implementation
no	yes, feeding scheme- staff effort	hard to tell, cannot teach a hungry child who has to care for sick parents etc after school
no	yes, paint - have to beg for sponsorship	its hard to tell how paint help curriculum implementation

Q8
compulsory parent meeting- informed about policy, ass req. and expectations
compulsory attendance meeting for parents-inform them about policy, req., expectations for them and children
have to attend meeting for parents told about policy, subjects offered and requirements
must attend meeting parents told about policy
parent meeting to tell them about policy, pass requirements-many do not attend
Compulsory gr. 10 FET parent meeting-told about policy, ass req. Our expectations of them and their children
compulsory parent meeting-informed about policy goals, ass requirements
compulsory parent meeting made aware of why policy came into being, its goals, ass requirements
compulsory parent meeting
compulsory parent meeting-inform them about policy goals and requirements
compulsory parent meeting
compulsory parent meeting
compulsory parent meeting-parents told about need for new policy, its goals, ass requirements
parent meeting told about new curriculum most parents don't attend
compulsory parent meeting, they are informed about the policy, its goals, and assessment requirements

Q9
no
no
no
no
no
no
no
no

no, they are accountable for child's progress
no
no
no
not directly SGB assists with sponsorships for resources
no
no

Q10

No	SGB not involved with curricular Matters-just informed about policy, goals are not neg.	informed at special meeting about goals etc
No	SGB informed about policy at staff/SGB meeting they are req. to be at comp. parent meeting	informed about goals, ass requirements
No	Informed by principal at SGB meeting about policy, its goals, requirements etc	learners not involved with curricular matters at RCL level- just told about policy
No	SGB informed about policy expected to support staff at compulsory meeting	RCL not considered in negotiation process
No	Informed at compulsory parent meeting about policy, its goals req.	learners are not involved with curricular policy matters
No	informed about policy, goals, req. at SGB meeting	subject teachers inform learners about subject policy requirements
No	informed by principal requested to be present at compulsory meeting for support	teachers do this in their classroom on a daily basis
No	informed about policy, goals, req. at SGB meeting	learners informed about policy, its goals req, during lesson time
No	SGB invited to a special meeting with staff and FET co-ordinator	RCL invited to special SGB meeting
No	told about policy by SEM and principal	told about policy by subject teachers
No	told about policy by principal and FET co-ordinator	subject educators do this
No	informed by SEM and principal	by teachers
No	told by SEM at a formal meeting with all school SGB's and principals	by educators in their classes
No	told about policy, its goals at SGB meeting	subject educators inform learners about policy, its goals, req
No	not informed about policy, goals not negotiated with them	during lesson time

Q11.1
rammed down your throat, cannot question goals/depth/content-just implementers
instructed to follow policy
no negotiation at all- received 4 days of training- training was a "sham"
just follow what they say, don't ask questions
instruct us to do this and that-no negotiation
just toe the line- negotiations unheard off
the word negotiate does not exist- they are policy pushers
we just implement what is decided by higher authorities
no negotiation with us
we are expect to follow what they say in a carte blanche way
instructed to implement policy- no negotiations
They only know what instructions are
instructed all the time to just implement policy
told to implement or your will be in trouble

no negotiations-policy slammed down your throat

Q11.2

content, depth, lo's -no clear guidelines provided on depth to be covered
lack of guidance on depth to cover, vastness of syllabus, curri. occurs within unique envir. of school
content vast- no guidance on aspects to be covered for testing -how do we write a common exam?
should be a common textbook for consistency in absence of proper guidelines
we are denying access to learners by changing weighting of exam to 75% and cass to 25%, content vast
exemplar paper language beyond comprehension level of learners- fewer learners doing LS
content too vast cannot cover all LO's and AS's -no guide. on depth-cannot prepare learners for common exam
lack of support material especially hypothesis testing
difficult to implement without guide. on content depth, no common textbook, no exemplar support material
length of syllabus, depth-no guide, marking load of teachers, no common text, need for support material
lack of guide, proper training, exemplar material
depth of content, volume of content, no guide on depth, no common schemes for exams
content too vast, depth no guide., textbook covers aspects to different depths, ?how to prepare learners for common exam
language of exemplar paper too difficult, decrease in no. of learners doing LS
lack of support material, hypothesis testing no exemplars, no guide

Q11.3

after implementing the LS curriculum. In 2006
after we started implementing the LS curriculum In 2006
after I started implementing the policy in 2006
after we started implementing the LS curriculum -they are valid suggestions
after implementation in 2006-parent and learners complained about exam weighting
after we analysed the exemplar papers
after implementation of curriculum
I needed help once we stated implementation in 2006
I experienced difficulty in implementing the curriculum
after implementation in 2006-parent and learners complained about exam weighting
FET meeting
after implementation began at grade 10 in 2006
after implementing curriculum
after we analysed the exemplar papers
after I encountered problems with implementation

Q12

No-we are made to feel incompetent if we ask question or make suggestion
no- they fall on deaf ears –they are only pleasant when officials from national office are around
they cannot hear our suggestions
they don't listen to us
they have their own agenda and cannot hear us
Never- they are very fastidious and defensive in their approach
not in this life time
our concerns/suggestions are futile
No-we are made to feel stupid when we make comment on the curriculum
never
our suggestions are a waste off time
no, they nullify all our concerns
no
no

never our suggestions fall on deaf ears

Annexure B10

Transcript of interview with provincial curriculum developer

R= Researcher PCD= Provincial curriculum developer

R: Which individuals were involved with the development of the NCS FET Life Science curriculum?

P.C.D: Mr. Mphahlele, Ronel Pretorius, Malcolm Bowie, E.M. Baloi, M.C.N. Phewa, C. Selepe, A. Night, Peter Preethall, Gugu Khmalo, Kantan Naidoo from national office **.(Line 2)**

R: Did the curriculum developers consult /contact/invite teachers/industrialists/other organisations to be involved with curriculum development with regard to content, SKAVs etc?

P.C.D: Teachers were represented by the unions however not all provinces sent union reps. The provinces that did send union reps were North West and Free State. We did **(Line 4)**

not have industrialists on the panel but we did have people from the university, **(Line 5)**

that is university of the North and P.E. and people from the technikons were also present, that is Guateng tech and S.A. tech. We did have the NCS FET Life Sciences curriculum posted on the DoE website for comments, suggestions from all South Africans so industrialists could have made comments on the website.

R: But a large percentage of our population do not have access to computers, many cannot use a computer how do you expect them to respond to the curriculum via the DoE website?

P.C.D: Yes we have to have a stating point so it was decided by National education to get public comments via the DoE website.

R: How are partnerships negotiated with industries/educators/employees with regard to SKAV's development and the goals of the NCS FET Life Sciences curriculum?

P.C.D: They were all invited to make inputs on the NCS FET Life Sciences curriculum via the DoE website, this is how we negotiated our partnership with everybody.

R: Why were individuals from the university and technikons included in the panel and not industrialists?

P.C.D: The universities and technikons prepare graduates for industry so they know what industry needs in these graduates

R: But most learners in South Africa do not have access to tertiary education and they have to enter the world of work directly from a school set up. How do we prepare these learners for the world of work and is it not an assumption that the universities and technikons know what industry needs in the graduates?

P.C.D: Yes, its correct most learners don't go to university etc. they have to go to work and yes we assume that universities and tech's know what industry needs in these graduates. But things are changing now with this policy and we have to start somewhere so it was decided by national office to include universities and tech's in the panel. We hope this way to prepare learners for the world of work.

R: Have any other efforts been made by curriculum developers to forge partnerships with industrialists/ educators/ employees with regard to SKAVs development and the goals of the Life Science curriculum?

P.C.D: They were all invited to make inputs on the NCS -FET Life Sciences curriculum via the DoE website. This is how we negotiate our partnership with everybody. Feedback was obtained from teachers via subject advisors to determine if educators encountered problems in implementing the curriculum.

R: From the feedback received via the subject advisors are educators experiencing problems in implementing the curriculum?

P.C.D: Subject advisors reported that teachers need to make a paradigm shift when it comes to implementing any curriculum. Teachers complained about OBE, C2005 and now they are complaining about NCS FET.

R: What are teachers complaining about in respect of the NCS FET Life Sciences curriculum?

P.C.D: Subject advisors reported that teachers complain about the length of the syllabus, the LO's ,the AS's. They always complain.

R: Are teachers justified in their complaints?

P.C.D: No, they were trained by subject advisors to implement and teach the new curriculum. The subject advisors were also trained on how to train educators, so curriculum implementation should be uniform in our province and the whole country.

R: Curriculum implementation is affected by many factors other than training. Do you agree?

P.C.D: No, they all received the same training and should implement the curriculum in the same way other factors in the school or community should not affect curriculum implementation.

R: Thank you for agreeing to be a part of this survey and answering the questions posed to you.

P.C.D: It was my pleasure

Annexure B11

Transcript from interview with National head of Life science and curriculum development

R=Researcher NCD=National curriculum developer

R: Can you please take me through the process that was involved in the selections of Curriculum developers. How were decisions taken/made and how were they carried through the process?
NCD: Curriculum developers were sought from all provinces in all 29 learning areas. Provincial subject committees were asked to make nominations at the end of 2001 and beginning of 2002 to the national office to from national subject committees of curriculum developers. Subject committees were formed in 2003 from the nominations received by national office. Only if a person was nominated by the provincial subject committee **(L5)**
then they could be on the national subject committee for curriculum development. These individuals who were nominated on the national subject committee for curriculum development had to be actively involved in the provincial subject committees.
R: Were educators involved in the development of the NCS FET Life Sciences curriculum?
NCD: Yes we did have educators involved via the unions in terms of coming up with curriculum statements. You must remember a very small number of teachers serve **(L10)**
on the provincial subject committees. Provincial subjects committees comprise of subject advisors, personnel from provincial curriculum unit, and personnel from tertiary institutions.
R: I know that a large number of the curriculum development panel comprised of individuals from tertiary institutions. Was there a particular reason for including these personnel from tertiary institutions in this panel of curriculum developers?
NCD: The reason why individuals from tertiary institutions were included, they are specialist in certain fields and have expertise in research, they can guide this process **(L15)**
of curriculum development based on empirical evidence. They would be in a position to link up FET to tertiary institutions, there would be a conduit from FET to tertiary education. Also to broaden the curriculum, make it more modern to suit globalisation need. Remember the curriculum that had existed i.e. Nated 550 was antiquated it did not serve much purpose in terms of skills development **(L20)**
R: Right
NCD: It did not serve us in terms of what the country needed with respect to skills development.
R: So eventually by including personnel from tertiary institutions we are hoping to have more skills development?
NCD: Yes, this would serve two purposes. Firstly to develop a broad skills base amongst learners in terms of the countries needs. Secondly to develop and empower personnel who serve on the curriculum development panel – to develop their strengths and abilities **(L25)**
as curriculum developers. A large number of these individuals from tertiary institutions are involved in teacher education and can help in transferring their skills to teachers they train.
R: A large number of our learners do not go to tertiary institutions, they have to enter the world of work. Did the panel of curriculum developers seek the advice of industrialists in developing the curriculum?
NCD: People were consulted from technikons and colleges- these institutions offer occupation related programmes so they know what skills is needed in the world of work as they train people. People from civic organisations, teacher unions were consulted **(L30)**
in the development of the curriculum. Industrialist could have responded to our request for comment on the curriculum that was posted on our web site. Obviously a very small percentage**(L32)**
of learners go onto **(**tertiary education while the majority have to go to work. This large proportion of learners formed our target focus. We needed to come up with a curriculum that suited /met the critical needs of our country and the 21ST centaury **(L35)**
i.e. high knowledge and high skills
R: Yes
NCD: In terms of socio economic development, equity, human resources development and so on. Remember South Africa comes from a very hurtful past and we needed to change the backlog created by the past.
R: Yes that is correct, what was the reason behind DoE's choice to have the NCS-FET Life Sciences curriculum posted on the DoE web site for comments from the general public?
NCD: We wanted the public to take ownership of the curriculum in the 29 learning **(L40)**
areas and to be involved in the process of curriculum development. B y public I mean school governing bodies, parents, learners, religious organisations, industry, unions etc. they were all invited to make comments on the curriculum. E communication,This is our method of forming partnerships with all stakeholders. This was done to

obtain feed back/comments from the public before any kind of finality was reached on the curriculum that was to be implemented in 2006.Subject statements were revisited on the basis **(L45)**
of comments received from the general and in some instances they were changed. Learning outcomes and assessment standards were also revisited after comments were received. This was done to empower the public with regard to curriculum development, they had an opportunity to share their experience/ ideas on skills development with us. This was done to try and form a sort of partnership with the general public in terms of **(L50)**
curriculum development and to engage the larger public with issues of curriculum development. We could always ask the question was the public adequately empowered to comment on the curriculum? We needed to start some where, so why not with the NCS- FET curriculum. Yes I do acknowledge that this may not have been the best method of communication but we did need public comment fast to start the implementation**. (L55)**
of the NCS- FET curricular in 2006. You must understand our past and where we are coming from it is better to have a few more people from the general public making comments on curriculum development rather than no comments from the general public.
R: Ja, I think this was the first time something like this was done in South Africa?
NCD: Yes, yes you remember I mentioned earlier about our hurtful past during apartheid, it was a very cruel system. **(L60)**
R: Yes
NCD: It was a few people, a minority who decided the kind of education the majority should receive. The majority did not take part in the decision making process neither were they given a chance to comment on curriculum issues. They were denied ownership or engagement with the curriculum in the past. Now we are trying to change that by giving the general public a chance to make comments on important issues like education. **(L65)**
R: So in other words by taking public comments into consideration during curriculum development this can be seen as a way of moving forward with curriculum development in South Africa?
NCD: Yes, we did, we certainly did
R: Did you receive a lot of comment from the public?
NCD: Yes we received quite a lot of general comment, suggestions from the public on curriculum development. In terms of Life Sciences we received comments on certain topics that we included into the curriculum e.g. evolution, cloning, stem cell research. Evolution is a contentious topic that is now included in the curriculum. We received comment **(L70)**
on these topics from religious organisations. Remember during Christian National Education evolution was a taboo topic.
R: Is it hoped by DoE that eventually more learners from the FET band will go to tertiary institutions and study further?
NCD: No, that was not our intention. We are not only focussing on tertiary institutions. We hope that more learners can enter learner-ships via Seta partnerships with FET colleges and industry with skills acquired via schools. A large number of partnerships are formed **(L75)**
with Seta/FET colleges/Industry.
R: Umm
NCD: Lots of funding is available for training and skills development via Seta. This is one way of encouraging this kind of partnerships / skills development in South Africa for e.g. construction industry, nursing, pharmacy etc. all have learner-ship available for skills development and human resources development. When learners leave school they **(L80)**
can enter the work place, job market with well developed basic/ entry level skills. With the new curriculum learners ought to be multi skilled and be able to move from one job to the next.
R: So in other words we are aiming to develop very generic skills in our learners?
NCD: We want to develop more skilled learners who can contribute to the socio economic development of our country. That's the reason why certain subjects like L.O. and **(L85)**
maths are compulsory. So we can develop a broader skill base that will allow learners access to work as well as tertiary education.
R: I have conducted a survey of 6 industries in KZN that used the application of Biotechnology in the production of their goods. These industries have in their employment non tertiary educated personnel involved in the application of Biotechnology.
NCD: Yes
R: Do you think there is a correlation/ interface between SKAVs developed via our Life Sciences curriculum and skills required in industry?
NCD: Yes, we are aiming to develop generic skills that are applicable to any job. We aim to develop adequate skills in learners so they can enter work, tertiary education **(L90)**
or a learner-ship. Our object was to develop multi skilled learners.
R: With regard to subject advisors, provincial curriculum developer and national curriculum developer is there a kind of hierarchical relationship amongst /between them when it comes to curricular matters? Please explain this relationship to me.

NCD: Yes, subject advisors report to their supervisors on curricular issues. Supervisors report to provincial curriculum developers who in turn reports to provincial director of curriculum unit. The provincial director of curriculum unit reports to the national head of curriculum development. What we are trying to establish at the national office **(L95)**
is a curriculum committee, where there is a direct link between the many members of the provincial and national curriculum unit and not just communication between the provincial director of the curriculum unit and national unit.
R: So there
NCD: Yes, in terms of the management of curriculum development and curriculum implementation. We meet every 2 to 3 months to discuss the feedback received **(L100)**
on curriculum implementation and need to review curriculum development, provide support etc. In terms of the subject advisors we are trying to establish a curriculum committee whereby they are involved and give feedback directly to the national unit of curriculum development.
R: So you see subject advisors as having a direct link to educators and hence curriculum implementation that is they will be able to report back more accurately as to what development is needed with regard to curriculum implementation?
NCD: Yes, yes you see subject advisors are the coal face of curriculum **(L105)**
implementation and negotiations and serve as conduits of policy negotiations they can do a lot to enhance curriculum implementation if they are included in the curriculum committee. I can liaise with subject advisors directly and know exactly how teachers are implementing the curriculum, the support teachers need.

R: Educators were trained by subject advisor for 3, 5 day to implement this curriculum. Who trained the subject advisors to train the educators?
NCD: The national department trained the subject advisors on this new curriculum and how it ought to be implemented. This training started in February /March 2005 **(L110)**
in all 29 learning areas. In 2006 subject advisors were trained in the grade 11 curriculum and how it ought to be implemented. In 2007 the national department trained subject advisors on the assessment aspect of curriculum development.
R: So educators have to be still trained on the assessment aspect of the curriculum?
NCD: Yes
R: Thank you for answering these questions, I appreciate you making time from your hectic schedule to accommodate this interview.
NCD: I am only to glad to assist you. **(L115)**

Annexure: B12

Transcript of interview with HR personnel- canning industry
R: Researcher HRP: Human resources personnel

R: Thank you for agreeing to be a part of this survey, you are assured of total confidentiality with regard to the answers to the questions posed to you. You are responsible for the human resources in your company and you have a vital role to play in employment, training of personnel and administrative duties associated with employment. Your company uses SKAVs from Biology which is currently known as Life Sciences. Do you think that industry i.e. companies similar to yours should make inputs about the Life Sciences curriculum?
HRP: No, that is not our responsibility.
R: Were you or your company asked/consulted by the Department of Education to make any inputs on the new NCS FET Life Sciences curriculum that was implemented in schools in 2006?
HRP: Not that I know off.
R: According to the curriculum developers industrialists were invited to make comments /suggestions about the NCS FET Life sciences curriculum via the DoE website. What is your comment to this statement?
HRP: I didn't know that the policy was on the website for comment. I am (L3)
supposed to just know about it without being informed. If they need our opinion they must ask us directly. Then only will we know that they need our comment, opinion, suggestion.
R: What do you mean by direct way?
HRP: They could invite us to a meeting.
R: Does your company have any kind of partnership with schools?
HRP: Yes, we provide sponsorships in the form of hampers to schools that request from us.
R: Does your company have partnerships with outside bodied to assist your non tertiary educated workers with their "learning/ training"?
HRP: NO

R: What type of training/empowerment does your company offer to non tertiary educated workers?
HRP: This is done "in-house" older worker who know how the job is to be done train the new recruits.
R: Thank you for agreeing to be a part of this survey

Annexure: B13

Transcript of interview of HR personnel- sugar industry

R: Thank you for agreeing to participate in this survey. You are assured of total confidentiality with regard to your answers to the questions posed. You are responsible for the human resources in your company and you have a vital role to play in employment, training of personnel and administrative duties associated with employment. Your company uses SKAVs from Biology which is currently known as Life Sciences. Do you think that industry i.e. companies similar to yours should make inputs about the Life Sciences curriculum?
HRP: No, that is the responsibility of the education department. That is a job they get paid to do, and they must earn their salary**.(L2)**
R: Were you or your company asked/consulted by the Department of Education to make any inputs on the new NCS FET Life Sciences curriculum that was implemented in schools in 2006?
HRP: I am unaware of being asked to make inputs about the Life Science curriculum. (L3)
R: According to the curriculum developers industrialists were invited to make comments /suggestions about the NCS FET Life sciences curriculum via the DoE website. What is your comment to this statement?
HRP: This is not an effective way of communication, we don't have time or a need to visit the DoE WEBSITE. I don't visit the DoE website for the day to day running of **(L5)**
my company. If they need our opinion they must ask us directly. If they want to get us to make comments about the curriculum
R: What do you mean by direct way?
HRP: By asking us to attend a brain storming session or by writing to a company via the head office or e-mailing us directly.
R: Does your company have any kind of partnership with schools?
HRP: Yes, sponsorships we provide financial aid to certain schools by sponsoring bill boards, we also offer bursaries to children of employees.
R: Does your company have partnerships with outside bodied to assist your non tertiary educated workers with their "learning/ training"?
HRP: Yes. But not always and this is only for certain workers who are keen to learn. If we train workers who cannot be an asset to our company we will be wasting a lot of money.
R: What type of training/empowerment does your company offer to non tertiary educated workers?
HRP: Skills training for interested, committed workers. All workers are educated about HIV/AIDS.

Annexure: B14

Semi structured interview with employee

1. Did you do Biology in schools?
2. Did you like/enjoy Biology in School?
3. Was it an important subject in helping you get your current job?
4. Are you aware that a new Life Sciences (biology) curriculum was introduced in schools in 2006?
5. Would you have liked to be invited to make comments on this new curriculum as a past Biology student and an employee who uses some biology skills in you current job?
6. Did you know that the DoE asked for your comments in 2003 0n their website?
7. Do you think this is an effective way of DoE to communicate with the people of South Africa?
8. Does your company offer any kind/type off on site training to improve your SKAV's?

Annexure: B15

Transcript of semi structured interview – non tertiary educated employee-(NTEE) canning industry

R: Thank you for agreeing to answer a few questions that I have to ask. I have the permission of your HR personnel to interview you. I assure you that your responses will be totally confidential and that the HR personnel will not know your responses. Tell me about the jog you do at this industry?
NTEE: I work in the canning section. I control the preservatives quantity, temperature, the mass machine and supervise the whole canning section.
R: Do you have any formal qualification, did you go to university or tech?
NTEE: No, I only finished matric.
R: Did you do Biology in schools?
NTEE: Yes
R: Did you like/enjoy Biology in School?
NTEE: Yes, it is an interesting subject.
R: Was it an important subject in helping you get your current job?
NTEE: Yes
R: How or why?
NTEE: We learnt to read, measure accurately, to work in groups. We learnt about temperature control, bacteria, technology and stuff like that. If I didn't do Biology at school I would not be in charge of the canning section. I would be an ordinary worker with a low wage.
R: Are you aware that a new Life Sciences (biology) curriculum was introduced in schools in 2006?
NTEE: No, I'm not aware of this
R: Would you have liked to be invited to make comments on this new curriculum as a past Biology student and an employee who uses some biology skills in you current job?
NTEE: No, that's not my job
R: Did you know that the DoE asked for your comments in 2003 0n their website?
NTEE: No
R: Do you think this is an effective way of DoE to communicate with the people of South Africa?
NTEE: No, many South Africans can't read and write how are they going to use a computer. This government is corrupt.
R: Does your company offer any kind/type off on site training to improve your SKAVs?
NETT: Yes, I was trained by an old man who had to retire. I was chosen above the other workers in the canning section because I am enthusiastic, I'm loyal to the boss.
R: Once again thank you for agreeing to be a part of this survey.

Annexure: B16

Transcript of semi structured interview – non tertiary educated employee- sugar industry

R: Thank you for agreeing to answer a few questions that I have to ask. I have the permission of your HR personnel to interview you. I assure you that your responses will be totally confidential and that the HR personnel will not know your responses. Tell me about the jog you do at this industry?
NTEE: I take care of sugar cane plants in the pollination lab. I control the amount of light the plants need, temperature, water and record these readings.
R: Do you have any formal qualification, did you go to university or tech?
NTEE: No, I just went to high school.
R: Did you do Biology in schools?
NTEE: Yes
R: Did you like/enjoy Biology in School?
NTEE: Yes, we had a dynamic teacher who made the subject hands on. We did lots of practical work. I went to an Indian school
R: Was it an important subject in helping you get your current job?
NTEE: Absolutely
R: How or why?
NTEE: We learnt skills during practical work that help us to do our jobs better, like reading temperature, measuring and if we didn't do Biology I could not work in the sugar industry and take care of the sugar cane plants in the

pollination lab. Then I'll be a labour like the other guys you can see, those ones who are pushing the barrow with the fertilizer.
R: Are you aware that a new Life Sciences (biology) curriculum was introduced in schools in 2006?
NTEE: Yes, my nephew was in grade 10 in 2006 and this is how I got to know that Biology is now called Life Sciences.
R: Would you have liked to be invited to make comments on this new curriculum as a past Biology student and an employee who uses some biology skills in you current job?
NTEE: Yes, we could tell people in charge how to include our experiences, skills needed to make the subject better so people can get jobs even if they don't go to university.
A: Did you know that the DoE asked for your comments in 2003 0n their website?
NTEE: No
R: Do you think this is an effective way of DoE to communicate with the people of South Africa?
NTEE: We don't have computers at home and this is an expensive way to talk to all the people of South Africa. You know in Mashu people don't have food to eat how are they going to get a computer? You tell me. This is not a good way to talk to the people.
R: Does your company offer any kind/type off on site training to improve your SKAVs?
NETT: Yes, skills development example computer training, I'm being trained to help in the Biotechnology lab, AIDS awareness. They are training me to talk about my job.
R: Once again thank you for agreeing to be a part of this survey

Appendix C
Annexure C1
Consent form: Life sciences Mediator

Dear Life Sciences colleague,
I am Ash Sing-Pillay a fellow Life Sciences educator and a PhD student, registered at UKZN. I am currently engaging in research that explores the relationship/interface between schools and industry provided learning with particular reference to the development of skills, knowledge, attitudes and values (SKAVs) in Biotechnology. This study is concerned with SKAVs developed/focussed upon during your mediation of the Life Sciences policy. You have been selected to have your mediation session observed for the second phase of data capture. I seek your consent to participate in my study by allowing me to observe your Life Sciences mediation session. Please note that your participation is voluntary. I assure you of total confidentiality.

Researcher: Ash Singh- Pillay
Student No.200302484
Cell No. 0844303795

Promoter: Dr. B.P.Alant
School of Science, Mathematics and Technology
Faculty of Education
Tel.No. 031-2607606

Declaration
As a participant in this study I understand that:

- My participation is voluntary, I am not being forced to take part in this study
- I may withdraw from the study if necessary
- I may refuse to answer any questions during our talks
- Anonymity will be guaranteed at all times- I will not be required to reveal my name and that in photographs that are taken my face will not be revealed but will be "blackened out"
- Confidentiality will be guaranteed at all times,

I_____ hereby confirm that I understand the contents of this document and the nature of this study. I consent to taking part in this study.

I understand that I am able to withdraw from the study at any time, should I wish to do so.

_____ _____
Signature **Date**

Annexure C2

Table: Exact SKAVs foregrounded in the gazetted policy-

Lo1:Experimental skills (28)	**LO2 (9)**	**LO3 (10)**
Following instructions	collecting and accessing information	identify and investigate scientific ideas and indigenous knowledge of past cultures
Making observations	identifying concepts, principles, laws, theories and models of Life Sciences in the context of every day life	compare scientific ideas and the Indigenous Knowledge of past and present cultures
Measuring trends	describe and explain concepts, laws, theories	critically evaluate scientific ideas and Indigenous Knowledge System of past and present cultures
Planning – identifying a phenomena	evaluate concepts, principles, laws , theories	describe different ways in which resources are used in the development of products
Questioning Making predictions	interpret,	report on how products impact on the environment and society
Hypothesising	organise,	compare different ways in which resources are used in the development of (bio-) technological products
Formulating and designing experiment or procedure to be followed	analyse	evaluate the different ways in which resources are used in the development of (bio-) technological products
recording information	compare concepts, laws, principles and theories	analyse and describe the different beliefs, attitudes and values on scientific knowledge and its application to society
Recognise experimental or technical problems in experimental design	application of Life Sciences knowledge to every day life	compare, debate and argue the strengths and limitations of different beliefs, attitudes and values in the interpretation of scientific knowledge and its application to society
		critically evaluate and justify

		positions taken on beliefs, attitudes and values that influence and relate to scientific and technological knowledge and their application to society
Data handling skill		
Identifying		
Selecting		
Organising		
Presenting		
Translating-drawing graphs, tables, maps Manipulating data		
Handling apparatus and materials		
Making models		
Making inferences		
Predictions		
Drawing conclusions		
Evaluating hypothesis		
Problem solving		
Transfer and apply conclusions to new situations		
Making deductions and conclusions from data gathered.		
Share findings in different ways- oral, report, graphs		
Reflect on reliability and validity of findings		

Transfer and apply conclusions to new situations		
Making deductions and conclusions from data gathered.		
Share findings in different ways- oral, report, graphs		
Reflect on reliability and validity of findings		

Annexure C3- Transcript of mediation of policy

Day one
T1: Hello Mags, congrats on your daughters 6A's

T2: Hi, how are you? I am so relieved its over, now we are waiting to see if she gets accepted at Natal for medicine

T1: You know, Vicky, his daughter got 6A's, a 92% aggregate and Natal did not accept her for medicine. Its so sad our children have to work so hard and they cannot get accepted close to home

T2: Its upsetting for me Sayuri got accepted at UTC,WSU, but she does not want to be away from home. If we don't get a response she will have to accept WITS. It's going to be so costly for me. It was a difficult year for her, what with her dad passing on and she being a Hare Krishna devotee, its difficult. If she goes I'm all alone here

T3: I am so proud of Sayuri wish her well for me and I hope she gets a place here at Natal

T4: did you here that Des, Ruben, Vinesh and Syrie have resigned and their schools are headhunting Life Sciences teachers

T1: Hey I met Mr. Moonsamy and he told me that 60 teachers resigned in Phoenix north in the last year
T4: Why is Ash here? You think she's back at school?

T1: Let's ask her, Howzit Ash what are you doing here?

Ash: I'm observing the mediation of policy

T4:Are you coming back to school?

Ash: I'm still on secondment, when that's over I will return to school

T5: Hey Ash what's happening in your cluster? There were 6 resignations after you left. Are you secretly organizing jobs for them at university?

Ash: No

T4: Did you come to check your school results and receive your graph

Ash: No I'm just observing the mediation of policy the subject advisor has consented to this

SA: Good morning people, everybody we have Ash present with us she is here as an observer and is capturing data , you'll remember her

T: we do

SA: Pops set up we are running late. While Pops is setting up circulate the attendance register please sign against your name and school address. **Do not sign for your friend who is not here as this is a form of misconduct andI can you can be charged for misconduct by the minister**. There are supposed to be 60 teachers here and only 56 of you have signed the register. **There are 4 errant teachers who have not signed the register as yet. Look at the time it's past 9 and they have not had the decency to call and explain their absence or lateness**. You know school begins at 7:50. Pops go to Losh and ask her to phone these 4 schools principals, Zinzilini Secondary, Oshlanga high, John Dube and Ogengeni and inform them that their teachers are not present at this workshop. I'm going to be very strict now, I can't have a principal thinking that his teacher who is not at school is sitting at this workshop while the teacher is elsewhere.

What if the teacher has an accident or is highjacked. You know that the department has granted us special permission to conduct this workshop during school hours. This training workshop was supposed to occur in October 2007 but due to teachers being on a national strike the workshop had to be postponed.

T6: This workshop is very poorly timed, we are out of school for 5 day and when we get back we have to completed term one Cass and have our learners ready for the provincial controlled exams.

T7: **Yes, it cuts across the first term which is already so short and we are losing out on instruction time, we have the IPSA games in soccer, volleyball and netball to contend with.**

T8: **I will away from school for 10 days as I have to attend the Life Sciences and Math Lit workshops. I will not be able to cove the syllabus, complete Cass requirements, fund raise, be involved in sport, deal with shortened periods and complete the syllabus in time to prepare learners for the provincial controlled tests. If the results are poor my principal will be mad at me.**

T9: Couldn't this workshop be conducted at another time.

SA: No, it could not I need to cover evolution with you as it is a new section in the NCS-FET Life Sciences curriculum. You have no experience in teaching evolution and some of you have no training in evolution as you teacher trainings intuitions did not cater for evolution in their curriculum. They were also guided by Christian national education principals.

T1:I have been to the EMS workshop and I can tell you I wasted my learners time, I should have collected the training manual and studied it at home and spent my time teaching my learners. We have facilitators who just direct our attention to what's in the LPG and they call this professional development for us. I sometime wonder about the training subject advisors receive to train us because the support we receive is pathetic. It doesn't demonstrate to us how to implement the curriculum it's a lecture that we attend.

SA: We are judged by the examination results in our regions, if the results are good it means that we have provided good guidance to you to implement the policy. That is one of the reasons why we are moved from one region to the next. I refuse to move from the Phoenix region you teachers produce the best results in KZN. Therefore I now control the Empangani region as well. But getting back to your concerns, remember I didn't call or ask you to go on strike. It was something you chose to do.

T4: Going on strike was for a worthy cause and we heeded the call of our unions.

T5: **What irritating is the lack of consultation with us in determining when we should have this training? Why could it not have been conducted in the first or second week of December 2007?**

SA: I'm involved in the matric exams marking and I'm unavailable to conduct the workshop

T4: So it all centers on you and suits your convenience, we are losing teaching time because you are busy earning a double pay cheque in December. That not fair.

SA: Let's not bring the matric exams into this as one of the examiners I am expected to be at the marking center to deal with queries.

T6:Well I want you to know that the number of learners pursuing Life Sciences at school is decreasing.

T4: That's true, I'm aware of the number of learners decreasing, its not a compulsory subject anymore and the papers are difficult, other papers have no shocks.

T3: I have 5 learners in my grade 12 class. I sometimes forget that I'm teaching in a public school with such a small class. I have to teach math lit and LO to make up my load

T4: Other subjects have one exam paper and the papers are not difficult, the syllabus is not lengthy nor does it change as often as the Life Sciences curriculum and they results are good.
SA: I know about the decrease in the number of learners pursuing Life Sciences at school

T3: Then if you know about it what are you doing as the Provincial head of Life Sciences?

SA: Other subjects have no shocks in the exam, 80% of the paper involves pure recall while 20% involves higher order thinking. So just by reading or paying attention in class a learner can obtain high marks in a subject like travel and tourism, hospitality studies, business studies. Life Sciences is " **It's a difficult, lengthy syllabus, other subjects have no shocks in the exam, I will take you through it step by step and show you what you need to focus on for good exam results… provide multiple opportunities for learners to master these testable competencies … remember practice makes perfect … use a drill method to teach." there are two exam papers of 2.5 hours each. The examination paper encompasses 40% LO1, 40% LO2 and 20%LO3. I am aware that teaching Life Sciences is stressful as you teach other learning areas and that you need more time for preparation, marking.** I empathize with you. Remember in Life Science recall only makes 40% of the paper so you are engaged in teaching a high powered subject.

T4: How does Umulasi account for this disparity in standards and levels of testing amongst subject within the FET band? What happens to the DoE's goal to broaden access in to science and math? What can be done to rectify this perpetuated injustice?
SA: Nothing can be done as high standards have to be maintained in Science if we are to develop high knowledge and high skills needed to compete locally and globally. You could use your good exam results to attract learners to do Life Sciences next year.
T9: I think we as the Phoenix North region are going to write a letter to Umulasi expressing our concerns in respect of the differentiated levels of testing amongst subjects, the need for consistency in levels of testing , the need to broaden access into Science.

T3: We still have to contend with our curriculum changing twice since its implementation in 2006 and its only 2008 how many time is this curriculum still going to evolve.

T1: We are not even consulted before the curriculum can change. Why did it change? We don't have time to get familiar with the new curriculum and before you get to grips with it change again. It's like we are hit by tidal waves each time the curriculum changes. It's confusing, it places a lot of stress on us , we have to forever check if we are teaching the correct thing , syllabus. Can't you make your minds up about what to include and in which grade. The curriculum developers and the curriculum are like a swing pendulum you are uncertain, it's a trail and error process for you to establish what works.

SA: The curriculum change both time because personnel from the higher education intuitions complained directly to the minister of education about the lack of plant physiology and animal anatomy from the Life Sciences curriculum.

T2:That problem could be easily be addressed in Botany 101 and Zoology 101 course. So we teach to make work easier for higher intuition personnel.

T3:The problem with policy formulation is that Higher Education personnel voices are heard and our voices is absent during policy formulation. Some HE personnel have little teaching experience and know little about the dynamics of school where the curriculum is implemented. They are oblivious to the impact frequent curricula changes has on our work load.

SA: I'm only sharing with you what caused these two curricular changes. Look at the time. I suggest that we take a 45 minute break. When we return at 11 I will give out the LPG for 2008.
SA: Shuks Eskom is at it again, we have load shedding. OK people please wait outside until further notice.

SA: Please come into the conference room. Its now 12, so I take it we will not have a lunch break. In order to complete today's scheduled activity, Pops let them sign for the LPG next to their school name.

Remember this document is to be used on a daily basis do not file it away into your archives. Please switch off your cell phone. I'm going to pass out the analysis of the 2007 Life Sciences matric results for my region. At a glance you could see those schools/ teachers that are achieving and those that are underachieving. **I took the liberty of drawing ranking tables for my schools in terms of percentage pass rate and quality of passes.** In table one I have included the school and teachers name, number wrote, number passes, number failed, percentage passed at 40% and 25%. Table two the symbol distribution of each school. Pops switch on the data projector so that we could jointly view the compression of each school results for the past three years. Rani and Mhlongo I see an improvement in your respective school results in terms of percentage of pass but you need to work on the quality of passes. How you do feel about this.
T8: I feel good that the percentage of passes has improved but I didn't like you discussing our results in this manner.

T7: **It is demeaning and embarrassing to us, it is a form of ridicule in front of all our colleagues. I didn't ask to be appointed at a previously disadvantage school were learns think in IsiZulu and then write in English. You don't know how hard it is to work in the condition I face. I work very hard, go the extra mile, have extension classes, we make a lot of sacrifices but at the end of the day the learners home background also plays a role in learners performance.** Don't get we wrong all I'm saying is that parents have a role to play in their child's performance. Many of the parents of learners in my school cannot read and write so how can they help their children.
T4: We function in different working environments, our learners are different, their social problems are unique so how can you compare our result?"

SA: I'm not asking you to be totally accountable for the learners result. I'm making an observation that your school results have improved over the past two years. Look your results is always scrutinized as it is published in the papers. If you are doing what is expected of you, you have nothing to fear. So have you benefited from the SEM's twining programme?

T7: Yes. I did with the frequent change in the curriculum and the three learning areas that I teach I needed help and the twinning programme provides you with all the assessments needed, tests are set for you so it reduced the work load of teachers.

SA: Now look at this table**, I call it a table of consistency these schools have maintained their 100% pass rate for the last 5 years in spite of the frequent curricula changes** they are Mountview , Seatides, Greenbury, Havenpark and Palmview. How do these teachers do it repeatedly? Would one of you like to share your secret with us?

T9: I make the learners write two tests per section covered. These tests arte based on past year exams papers. The whole assessment programme is designed to ensure learners excel in the exams, have sufficient practice to master testable SKAVs.

SA: Mr. Naidoo should I ask you or Ash to comment on your school results

Ash: Mr Naidoo will comment I'm just here as an observer of the mediation

T10: All I'll say was a standard was set by mam and I had to maintain it, fortunately she left all her teaching resources for my use and all the assessment were set by her so I only had to focus on teaching .It saved me a lot of time. Also she had intervention lessons for the learners two days before the learners could write so what they need to know to is fresh in their minds

SA: Manie what do you have to add to what's said already

T11: I only teach for 30 minutes the other 30 minutes is used for consolidation- learners engage in answering past year exam questions. This allows them to master the SKAVs that are testable in each section. The work is reviewed orally and learners correct their own work and identify the errors they make. I pitch my teaching towards the exams.

SA: **I hope the others have been making notes on these teachers' strategies and you should consider doing this so that our results will improve.** Remember as teachers you are judged by your school matric exam results. Tomorrow we will compare the Nated 550 policy with the FET policy.

Day 2

SA: Good morning everyone. Pop's circulate the register those four teachers who were not here yesterday and are present today come and collect your LPG from me and ensure that your sign for it. I hope this is an example for the rest of you not to abscond the training session. I will not be accountable for teachers who are supposed to be at my workshop and are else where. Those four teachers you will have to attend day one on the training session at the Chatsworth teachers' center. Please follow these house rules- all cellular phones must be switched off, there will be no requests to leave early, all materials supplied is an property of the school but is to be used by you on a daily basis. Pops is the data projector ready. Slide one reflects a comparisons between the NATED 550 policy and the NCS-FET policy. The Nated 550 policy was designed during the apartheid era, was based on Christian national education principals, favoured content testing in the exams, remember recall and L1 question made up 60%, Comprehension L2 made up 30% and L3&4 made up 10% of the exam paper. This was a content driven policy that encouraged rote learning. **The NCS-FET policy is far superior than the Nated policy, was designed in the post apartheid era, it embraces IKS and evolution, aims to broaden access into science, favours the testing of SKAVs in the exams.** The NCS-FET aims to develop high knowledge and high skill in learners, favours learner centeredness. I am pleading with you to remember that the FET exam is **different from the Nated 550 exams. The FET exam is SKAVs based and not content driven.** You cannot teach Life Sciences like you taught biology in the past. It is critical that you understand the three LO's and the 9 AS's. You must infuse the LO's and the AS's in your teaching and assessment. You must teach from the LPG and not the textbook. All textbook do not align themselves with the LPG requirements, they don't focus on the depth required, and there are some inconsistencies in terms of concepts, accuracy of content. Note some textbook authors do not have a formal qualification in biology but their job is to write textbook for example there is one author who has written books in Life Sciences, Geography, math, Life orientation, travel and history. It is important that you teach skills rather than content. The weighting of the FET Life Sciences exam paper is 40% LO1, 40% LO2, 20% LO3. The AS's of each LO indicates the competency to be tested. I'm urging you to **use a drill method to teach LO1 especially hypothesis testing, translation of data, designing of experiments**. You've heard your successful colleagues yesterday. They use past year exam papers to train and prepare their learners for the exams. It's all about the exams at the end of the day. Include these competences in all your tests, class exercises, assessments, cluster papers. Cluster coordinators it is your responsibility to ensure that these competences from part of all assessments. **Multiple opportunities must be provided to learners to master these highly testable competencies.** When it comes to LO2 learners will not be expected to merely recall information they will be tested on other LO2 competences as per the slide. Mostly of the competences that I have just highlighted must be mastered by learners, mastery will led to good exam results. You are aware that there is a tension hype about the first FET exam results. Good exam results will dispel public parents, opposite parents fear and concern about the implementation of the NCS FET curriculum. The feeling on the ground is the policy was implemented before schools and teachers were properly trained. We will break for tea please be back timeously at 10:30 so that you can have a 1 hour lunch break from 12:15 to 13:15 and we can complete today's lesson at 14:30

SA: Like I was saying before there is deep concern about FET policy, **the public feels it was implemented before teachers were properly traine**d and its implementation and the first FET exam by politicians, academics and the general public. They are extremely critical of this new curriculum so we need good exam results to stop the criticism. The public is expecting poor results but if the results are **good it will show that the FET curriculum is successfully implemented and it will dispel their myths about the FET curriculum and its implementation** and weather teachers are prepared to implement it. If learners master the LO1 and LO2 SKAV's pointed out in the slide they can produce good results and good results will attract more learners to Life Sciences. Good results will show that teachers understood the goals of the curriculum and implemented it successfully. You know I am extremely proud of the Phoenix north region as you'll always produce a higher pass rate and better quality of results than other regions in KZN. It is this region that really boosts our provincial pass rate and quality of passes. So remember I'm encouraging you, you have to maintain the standard and image of the region, SEM, principal and provincial DOE. Your

results are a reflection on me **I am on the exam panel and I design this mediation to focus on exam, sits important that my region produces the best results.** Well done to all of you and this sentiment is also shared by your SEM. Remember your learners exam results affects your IQMS scores and weather you get matric marking or not.

T5: I disagree with your comment on good results allows one to get matric marking. I have produced a 100% pass rate for the past 4 years and I have applied for marking for each of those 4 years only to be unsuccessful in my application.

SA: You know your unions have a say in the appointment of markers. I only choose a set number of teachers as senior markers. If I had monopoly over the appointment of markers I will use every teacher from this region as I'm confident that you will read the learners answers critically and see if it is an alternative answer to the predetermined expected memo. Every year after the results are released we have hundreds of applications for re-marking due to the poor quality of marking and those marks really change last year I recall a learners mark increased by 40%, that a symbols on its own.
T7: If the exam results are bad will the IQMS scores of those teachers change. This should happen to schools that repeatedly produce poor exam results .These is no consistency in the allocation of scores when it comes to IQMS, it differs from school to school, region to region. We engage in a multitude of activities such as sport, fund raising, co-curricular activities as compared to those school that are underachieving and at the end we all get the same increment of 1%. So what the point in rating us, its fascicle if we all get the same benefits and works on different performance levels. Please take all our concerns raised to your superiors in the department.

SA: I have noted your concerns and will present them to the curriculum unit but you know that your union has a stance on IQMS scores. Ok get into groups of 6 as you are seated and complete this task on hypothesis testing. Pops pass out the task.

T1: We had the example in this task on two previous workshops, is this the only example you have on hypothesis testing

T4: Yes you are right, is there a lack of exemplars , if that is the case how can we get our learners to master hypothesis testing.

SA: You must understand that this curriculum has just began and we are still creating a data base. But present your hypothesis so we can see where you went wrong

T5: What's the point, we still remember the answer its simple recall for us- its not like this is a different example and we are thinking about it.

SA: Ok let's break for lunch be back at 13:15 so we can conclude by 14:30

SA: I will now focus on the NCS-FET exam and unpack the LO's and AS's that the important for the exams. They are LO1: hypothesis testing, translation of data, drawing of tables, identifying trends LO2- will not be tested as pure recall, learners will be provided with a case study and they will have to access information and evaluate it LO3 this will form part of the essay question encourage your learners to debate issues relation to science and the environment. For paper two the same applies but please recap the grade 10 and 11 concepts on environmental studies- those relating to ecology. Its important for learners to remember these terms. Ensure that your lesson plans reflect the LO's and AS's you hope to develop in learners. You are expected to develop lesson plans foe each topic not each lesson. Do them properly as they impact on your IQMS scores. All tests must have a diagnostic analysis to reflect areas of weakness and how these weaknesses were rectified. When I call at your school I will examine the following: lesson plans, forecast, work schedule, tests and Cass file. Remember for CASS assessments there is no group work. Ensure that all Cass assessments are set and moderated at a cluster level and cluster co-coordinators ensure that the competencies emphasised are included in each piece of Cass ans mastered. Remember practice makes perfect and leads to good results in the exams. Tomorrow we will work with the draft exemplar paper 1 and 2. So you know how to prepare your learners..

DAY 3

SA: Good morning please sign the register, Pops pass out the exemplar papers and the transparency grid and transparency pens you will be working on paper 1 from now till tea. You will get into groups of 6 as you are seated and you will categorise each question in respect of the LO and AS it tests. After tea you will present your categorization using the OHP. Teachers talk in their groups and identify the LO and AS in each question.

There is a debate going on next to me if LO1 is only applicable to hands on practs. A member of this group argues that a pract can be minds on as well and will still be LO1. Eventually her argument is accepted.

SA: Sorry about the lights we will have oral presentations at the end of the day for now you can work an exemplar paper 2. Pops pass out the exemplar paper2 and grid so they can continue till lunch time ie 12:15. Sorry people its 12:15 and we still do not have electricity; the kitchen staff has not been able to provide lunch for you. Let's disband for today. I will see you tomorrow.

DAY:4

SA: Good morning please sign the register lets spend 30minutes reviewing your activity that was complete yesterday. For now we will only focus on section B question 2,3 and 4 of each paper. Satish how did your group categorise question 2?

T6: The entire question involves LO1 as it is based on investigative work and the following AS's are tested AS2 and AS3

SA: Do the rest of you agree with Satish's group?

T: Yes
SA: Morgan how did you'll categorized question 3?

T4: Question 3 involves a case study were learners have to read access, interpret and apply so it involves LO2 and the AS'S are AS1 and AS2

SA: Does everyone agree with Morgan?

T: Yes

SA: Manie's group how did you'll categorize question 4?

T11: The case presented in question 4 relates to LO3 as it seeks the attitudes and values of people towards Albinos in the past and present. I can also say its LO2 as the learner will have to read, access, and interpret information before he/she knows what the attitudes and values are.

SA: Do the rest of you'll agree with Manie;s group?

T: Yes

SA: Hold on a minute every question requires the learner to read and make sense before answering it, so all questions will involve LO2.

T: I think that when we are categorising LO's we need to look for key words in the questions to differentiate between LO1, LO2 and LO3. If all questions involve LO2 we will be reverting to the Nated Policy. Page 9 of the LPG has this.

SA: People its important that you are familiar with the LO's and AS's read the LPG; treat it like your bible or Gita . Let's move on to paper 2. Shoba's group for question 2

T: Question 2 involves LO1, AS1, AS2 andAS3 as the learner has to state a hypothesis, interpret results, draw a graph from a table and explain how the design of the experiment could be improved

SA: Do the rest of you'll agree?
T: Yes

SA: Rajen's group classify question 3

T: question 3 involves LO2 as the learners were present with a textual information and they had to access information, interpret and apply so AS1 and AS2 were tested for LO2.

SA: Correct the last question, 4. will be done by Mchunu's group

T: This is the essay question so it'sLO3. We are having difficulties with the AS's

SA: Please read your LPG. Its not meant to be filed at school. It's for your daily use. We'll break for tea now, be back promptly at 10:15. Pops ensure that the data project and other hand outs are ready for the next session.

SA: Ok now we will focus on evolution. This is a new section in the syllabus and all of you have no experience in teaching it. There are some of you who have no knowledge of it as it was not part of your teacher training programme. This is an interesting section.

T: It conflicts with our religious belief's. So how can we teach evolution when we do not accept its principals. Including evolution in this curriculum is going to confuse learners about their religious beliefs. Imagine your child goes to church and declares that we have evolved from ape's, talks about the big bang theory this will distance the youth from their religious beliefs and learners will rebel and not accept their religious teachings. So why was it included in the curriculum with out consulting us?
SA: Hang on, you and the rest of South Africa were all asked to make your comments and suggestions to DOE on the proposed NSC-FET LS Policy in 2004 Remember the proposed policy was the DOE website and you had to make your inputs via internet.

T: That is such a stupid way to ask for comments. Most of us do not have internet or computers. It is a know fact that a very large percentage of our population is illiterate, they are poor, have no electricity and now we use first word methods of communication. Let's do a quick survey. How many of the 60 present here have internet raise your hands? Only 4. How many of you have computers? Only 10. So can you see the challenges we are faced with. Imagine what these stats are like in the rural regions

SA: Ok people I know you are upset that you could not make your input when the policy was being finalised but **it is gazetted now and you have to teach it. That's** the bottom line. I will take you through it step by step and show you what you need to focus on for the exams. On slide 1 are the terms that must be discussed as it will appear in the exam. They are: species, population, biodiversity, extinct, evolution, variation. Slide2 focuses on theories of evolution: there are two theories that need to be focused upon Lamark's theory of use and disuse. The second theory is Darwin's theory of natural selection and variations. Here learners must know why Lamark's theory was rejected and Darwin's theory was accepted. Inform learners of the alternative view to evolution namely: Creationism. Slide3: focuses on extinction theory- there are two types of theories that can be tested namely those associated with the earth itself there are 5 of them namely diseases, ice age, volcanic theory, plat tectonics, continental drift. The second extension theory is known as Extra terrestrial theories- they must be able to explain the factors responsible for extinction. Slide4: Draws you attention to evidence for evolution: The learner must know how fossils are formed. There are 4 different types of evidence for evolution namely* comparative anatomy-will be tested via diagrams. *Comparative embryology- will be tested via diagrams. *Comparative biochemistry-will be tested via diagrams and* biogeography- will be tested via diagrams. Here drill learners into

identifying similarities and differences between the diagrams related to each type of evidence for evolution. We will break for lunch now.

SA: We will continue with Slide 5- This slide draws our attention to human evolution: here you will compare humans to apes in terms of cranial difference and bipedalism.
Slide:6 show prominent hominid fossils found in South Africa. You could use a video as a resource to teach this section. Please study the manual provided for the content. Tomorrow we will wrap up and complete the evaluations forms.
T1: You have not showed us how to teach this section, you have merely highlighted what we need to teach or what learners must know for the exams. How do we teach this section? You have merely discussed the content with us but not the pedagogy.
T2: This whole training is on the exams, is the exam so different this year. What is DOE worried about? That the results will be bad. We are drilled into focusing of certain SKAVS so its all about the exam. What about teaching for understanding

SA: Yes, its always all about the exam, good results is what counts. Good results open doors for learners to Higher Institutions. I know you still use chalk and talk in your teaching with a bit of discussion, group work and you use demonstrations for practical work. I know that you rely heavily on chalk and talk. That's the best method to use to teach learners and get them to learn so they pass, go to university, and get jobs.

T: Most of the learners we teach can't afford to go to university, there is more to school than just passing exams.

DAY:5

SA: Good morning lets complete the evaluation form, update your data base and then you may leave. You do not have to go back to school. Pops hand out the forms. Once you complete them you may leave. No lunch or tea will be provided for you today.

Annexure C4:Analysis of mediation of policy

	Which actors do SA's see as impacting on their practice?	**How do they interpret the effects of these actors?**	**What is their response?**		**Comment**	
…far superior than Nated policy -embraces IKS and evolution -broadens access into science - favours the testing of SKAVs -Not content driven, but learner centered -different from Nated 550 -learners are not expected to merely recall information	NCS NATED Curricular content Teaching approach Learners /learning	Superior Unique in character	Using the table of consistency to highlight "best practice"(best practice equated to good results) We are judged by exam results -its all about exams -its always all about the exams Good results is what counts As teachers you are judged by your school results		**As superior:** • alliance formation (DoE) • affirmation of policy(in terms of curricular content, assessment) • subversion of policy- i.r.o. exams results use to determine best practice & kind of learner that emerges	convergence divergence
-Deep concern about implementation -deep concern about FET exams -Tension, hype about first FET exam-feeling policy was implemented before schools and teachers were properly trained -good results will dispel fears and concerns of public about implementation -good results will stop criticism -good results will show that the curriculum is successfully	NCS policy Curricular goals FET policy myths Assessment - NCS-FET exam Good results Teachers Training Schools Public Data base	Premature Powerful – power brought about by good results	Focusing on the how and what in the preparation of learners for exams		**As premature and powerful (**its premature due to "early implementation, its powerful due to the power of good exam results) • alliance formation • affirmation of policy • subversion of policy- in terms of drill teaching approach, image of learner/teacher	convergence divergence
			How teachers (drill method)and learners (multiple practice)	what teach LO1- (hypothesis testing, translation of data, drawing tables and graphs, identifying trends) LO2 - concepts use past year exam papers include all competencies in assessments		

implemented, dispel myths about FET curriculum -This curriculum has just begun, we are still developing a data base -Its gazetted now and you have to teach it. That's the bottom line Good results will show that teachers understood the goals of the curriculum and implement it successfully						
I'm aware that numbers of learners pursuing Life Sciences is decreasing Good results will attract more learners to Life Sciences	Numbers decreasing Good results	Poses a danger to the survival of the Life Sciences Epicenter/ force field/gravitational pull	Mediation foregrounds exams Derive pride from good results		**As endangered:** • Alliance formation • Affirmation of policy • Subversion of policy i.r.o. no. of learners decreasing	convergence
It's a Difficult, lengthy syllabus • Two exam papers • high powered teaching is stressful • Only 40% recall • high standards have to be maintained • Frequent curricula changes-curriculum changed both times because personnel from	Syllabus associated actors: exams, frequent curricula change, assessment, teaching	As Hindrance/obstacles to implementation	Mediation foregrounds the how and what of what needs to be done during implementation – with exams being the key driver Obstacle referred/differed to policy requirements, w.r.t. assessment requirements (administer diagnostic test etc.)		**As a hindrance:** • Affirmation of policy • Alliance formation	convergence
			how teachers-drill learners	what -categories questions in terms of LO's &As's -familiar with LPG -Highlight curricula content of evolution-terminology, identify, differentiate, compare		

Higher Education Institutions complained to the minister						

AnnexureC5: Elaboration of NCS-FET policy document

What is the NCS

The NCS Grade10-12 represents a policy statement for learning and teaching in schools located in the Further Education and Training (FET) band. The NCS Grades 10-12 gives the expression of what we as South Africans regard to be knowledge, skills and values worth learning. The following principles have guided the development of the NCS Grades 10-12 namely, democracy, human rights, social justice, equity, non racism, non sexism and ubuntu (human dignity). The FET band is located between General Education and Training (GET) i.e. grade R-9 and Higher Education and Training (HE). Hence the NCS Grade 10-12 shows progression from GET and provides access to HE. The Nationally set curriculum is internationally benchmarked. It caters for modern 21st century skills and focuses on Africa and South Africa The curriculum lays the foundation for life long learning and different career paths. The NCS Grade 10-12 ensures that learners acquire and apply knowledge and skills in ways that are meaningful to their own lives. The curriculum promotes the idea of grounding knowledge in local context. This help to make the content relevant and meaningful to the lives of learners.

PRINCIPLES OF THE NCS

The NCS Grade 10-12 is based on nine principles drawn directly from the constitution. We will examine each of these guiding principles and how they impact on education.

Social transformation

Social transformation in education is aimed at ensuring that the educational imbalances of the past are redressed, and that equal educational opportunities are provided for all sections of our population. If social transformation is to be achieved then all South Africans have to be educationally affirmed through the recognition of their potential and the removal of artificial barriers to the attainment of qualifications. This allows for recognition to be given to individuals who, during the apartheid era, had no formal qualifications but the relevant practical work experience.

Out comes based education

OBE forms the foundation for the curriculum in South Africa. It strives to enable all learners to reach their maximum learning potential by setting the Learning Outcomes to be achieved by the end of the education process. The NCS builds its Learning Outcomes for grade 10-12 on the Critical and Development Outcomes that

were inspired by the Constitution and developed through a democratic process. The Critical Outcomes (CO's) require learners to be able to:

-identify and solve problems and make decisions using critical and creative thinking,

-work effectively with others as members of a team, group, organisation and community,

-organise and manage themselves and their activities responsibly and effectively,

- collect, analyse, organise and critically evaluate information,

- communicate effectively using visual, symbolic and/or language skills in various modes,

- use science and technology effectively and critically showing responsibility towards the environment and the health of others and

- demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation.

The Development Outcomes (DO's) require the learner to be able to:

- reflect on and explore a variety of strategies to learn more effectively,
- participate as responsible citizens in the life of local, national and global communities,
- be culturally and aesthetically sensitive across a range of social contexts,
- explore education and career opportunities and
- develop entrepreneurial opportunities

High knowledge and high skills

The NCS grade 10- 12 aims to develop a high level of knowledge and skills in learners. This set up high expectations of what all South Africans learners can achieve. Social justice requires the empowerment of those sections of the population previously disempowered by the lack of knowledge and skills. The NCS specifies the minimum standard of knowledge and skills to be achieved at each grade and sets high, achievable standards in all subjects.

Integration and applied competence

Integration is achieved within and across subjects and fields of learning.

Progression

Progression refers to the development of more advanced and complex knowledge and skills. The Subject statement shows progression from one grade to another. Each LO is followed by an explicit statement of what level of performance is expected of that outcome. Assessment standards (AS's) are arranged in a format that shows an increased level of expected performance per grade. The content and context of each grade will show progression from simple to complex.

Articulation and portability

Articulation refers to the relationship between qualifications in different National Qualifications Framework (NQF) levels in ways that promote access from one qualification to another. This is important for qualifications falling in the same pathway. Portability refers to the extent to which parts of a qualification are transferable to another qualification in a different learning pathway of the same NQF band/level.

Human rights, inclusivity, environment and social justice

The NCS grades 10-12 seek to promote human rights, social justice and environmental justice. All newly developed subject statements are infused with the principle and practices of social and environmental justice and human rights as defined in the Constitution of South Africa. The NCS is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors.

Valuing indigenous knowledge systems (IKS)

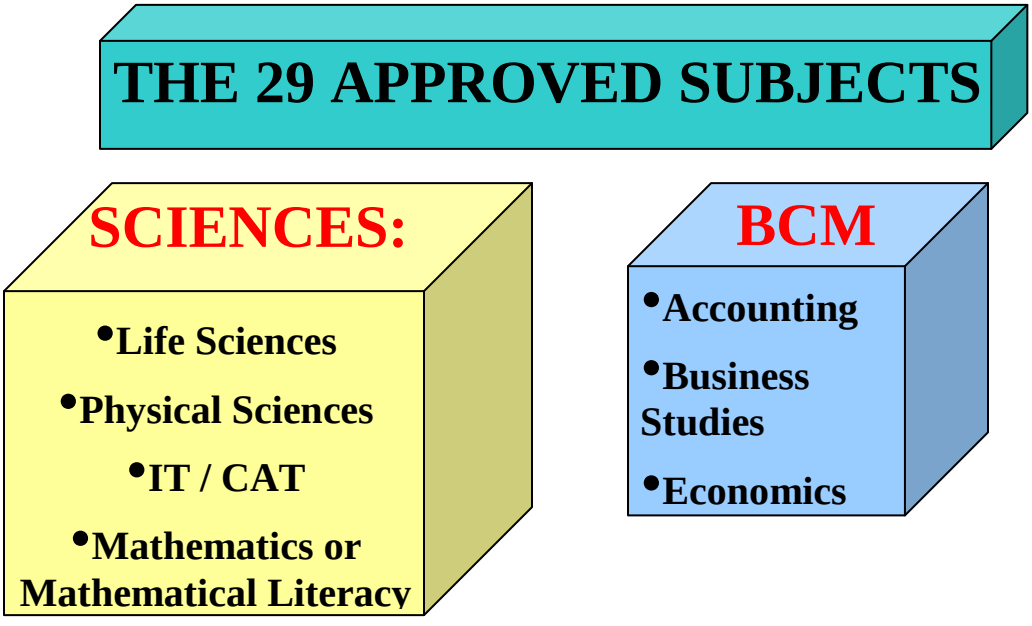
The Western world only valued logical, mathematical and specific linguistic abilities and rated people as intelligent only if they were adept in these ways. Now recognition is given to the diversity of knowledge systems through which people make sense of and attach meaning to the world in which they live. Indigenous knowledge systems in the South African context refer to a body of knowledge embedded in African philosophical thinking and social practices that have evolved over thousands of years. The NCS has infused IKS into subject statements. It acknowledges the rich heritage and history of our country.

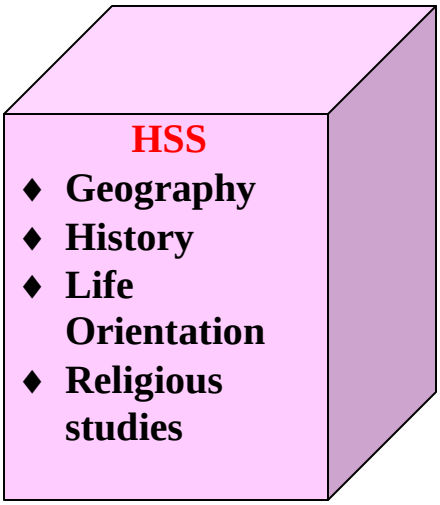
Credibility, quality and efficiency

The NCS grade 10-12 aims to achieve credibility through pursuing a transformative agenda and by providing an education that is comparable in quality and depth to those of other countries.

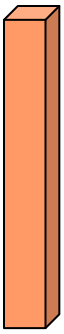
STRUCTURE AND DESIGN FEATURE OF NCS

The subjects in the NCS grade 10-12 are arranged into learning fields. A learning field serves as a home for cognate subjects. There are eight learning fields with 29 subjects as depicted below.





AGRICULTURE



- Agric Sciences
- Agric Management
- Agric Technology

LANGUAGES

- 11 official and 13 non-official

ART

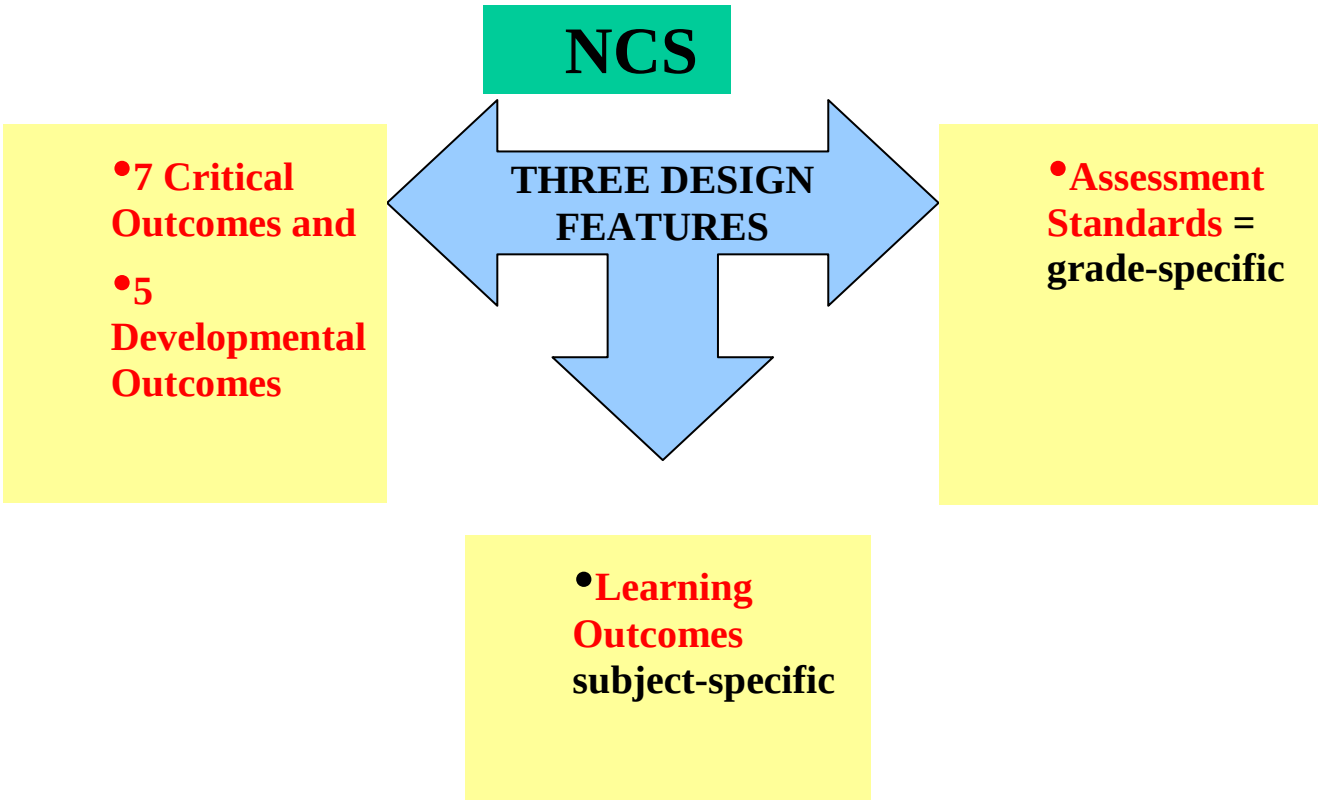
- Dramatic Arts
- Visual Arts
- Music
- Dance Studies
- Design

TECHNOLOGY

- Engineering Graphics and design
- Electrical Tech
- Civil Tech
- Mechanical Tech

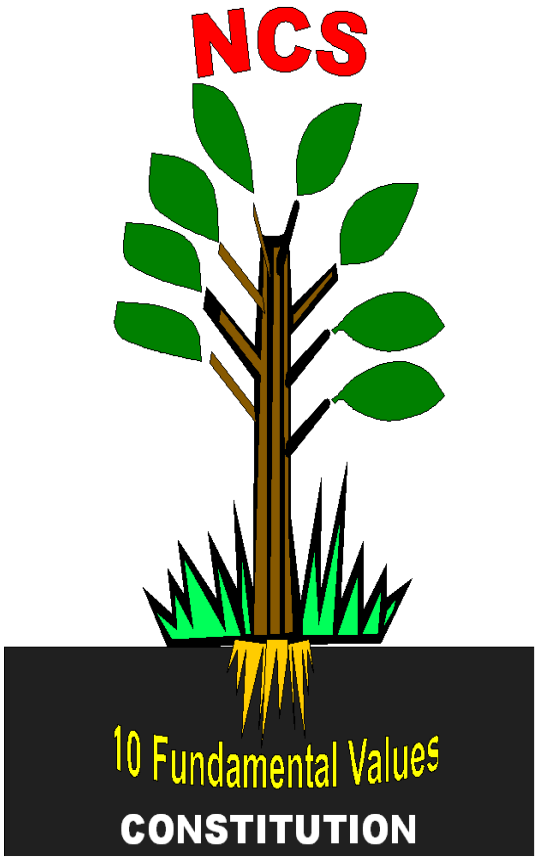
SERVICES

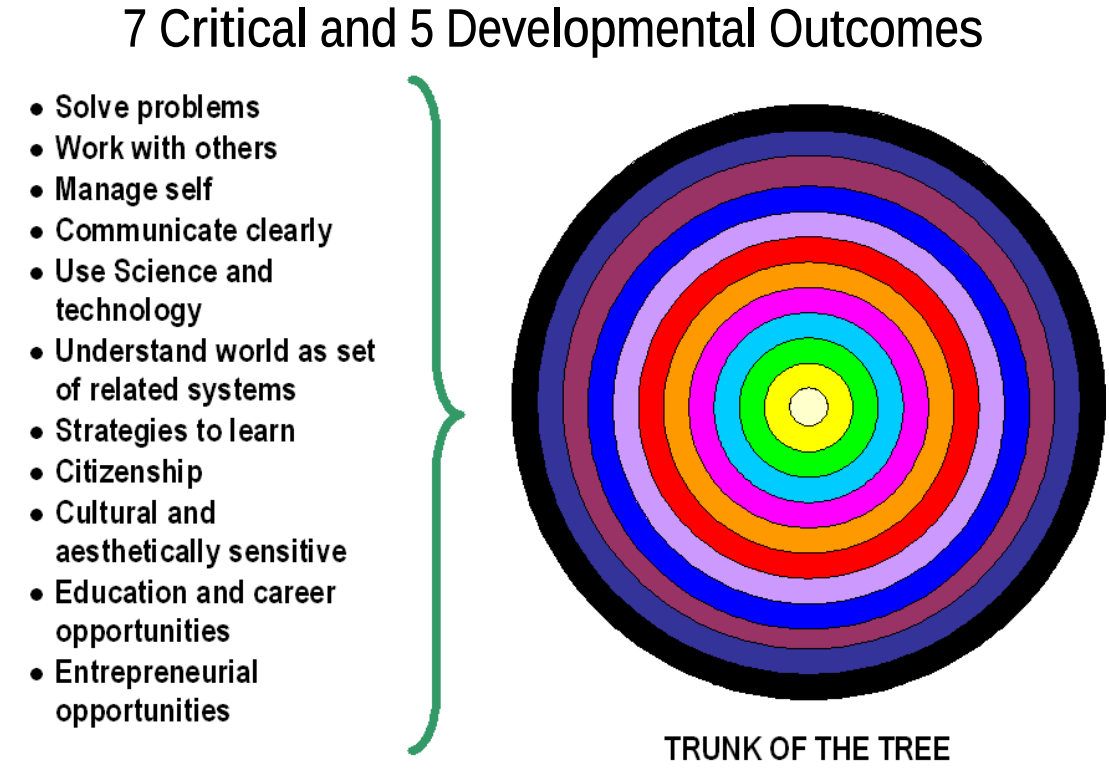
- Consumer Studies
- Tourism
- Hospitality Studies



The seven critical outcomes and five developmental outcomes are drawn directly from the fundamental values of the constitution. Learning outcomes are subject specific and they describe the knowledge, skills and values, (KSV), to be acquired by the end of grade 12. The learning outcomes are drawn directly from the critical outcomes and development outcomes. The assessment standards are grade specific and are an indication of the content, (KSV), to be taught to achieve each learning outcome. A tree analogy is used below to depict the interdependent relationship that exists between the AS's, CO's, DO's and the nine fundamental principles drawn from the constitution.

TREE ANALOGY EXPLAINING THE DESIGN OF THE NCS	
ASs leaves of the tree	=
LOs branches of the tree	=
COs and DOs trunk of the tree	=
10 FUNDAMENTAL VALUES roots of the tree	=
CONSTITUTION soil in which the Fundamental Values are grounded	=





NCS-FET LIFE SCIENCE DOCUMENT

There are three learning outcomes in Life Science that focus on the development of science process skills, development of high knowledge and application of knowledge to society and technology (DoE, 2003).

Learning Outcome one focuses on exploring and investigating environmental, biological and technological systems in everyday life. This can be achieved by using inquiry, problem solving and critical thinking skills. This involves the use of experimental and data handling skills. Experimental skills include following instructions, making observations, measuring trends and recording information. Data handling skills involve identifying, selecting, organising, presenting, translating, manipulating data, making inferences, predictions, hypothesis, deductions and conclusions from data gathered. Currently, it is expected that teachers ensure the acquisition of a range of 38 science process skills, by learners as directed by the interim Biology curriculum and the guideline document for National Examination (DoE: Interim core syllabus for Biology, 2000, Guideline Document for National Examination,2002).

Learning Outcome two involves the construction of knowledge by learners by collecting/ accessing information and experiences from the world around them. This learning outcome allows for the recognition of prior learning. This outcome allows for the use of inquiry and thinking skills to interpret, apply and extent their understanding of concepts, principles, laws, theories and models.

Learning Outcome three focuses on different ways of knowing and recognises indigenous knowledge systems. It raises the learners' awareness to the existence of different viewpoints in a multicultural society and encourages open-

mindedness towards all view points. This outcome acknowledges that people from other cultures developed other ways of thinking and different knowledge, and have contributed to scientific innovations by making their indigenous knowledge available to scientists from the western framework of science. Learning Outcome three highlights the fact that all forms of scientific knowledge need to be explored and critically evaluated. In learning outcome three learners are encouraged to become responsible citizens by evaluating the past and making informed decisions about the present and future.

IF the three outcomes discussed above are implemented as envisaged in the NCS FET policy document then the kind of learner emerging from the FET band will act in the interest of society, will respect the principles of our constitution namely, democracy, equity, human dignity and social justice.

Appendix D

Annexure D1

Consent form: Life sciences teachers

Dear Life Sciences colleague,
I am Ash Sing-Pillay a fellow Life Sciences educator and a PhD student, registered at UKZN. I am currently engaging in research that explores the relationship/interface between schools and industry provided learning with particular reference to the development of skills, knowledge, attitudes and values (SKAVs) in Biotechnology. This study is concerned with SKAVs developed/focussed upon during your Life Sciences lesson. You have been selected randomly to have your lessons observed for the third phase of data capture. I once again seek your consent to participate in my study by allowing me to observe your Life Sciences lesson. Please note that your participation is voluntary. I assure you of total confidentiality.

Researcher: Ash Singh- Pillay
Student No.200302484
Cell No. 0844303795

Promoter: Dr. B.P.Alant
School of Science, Mathematics and Technology
Faculty of Education
Tel.No. 031-2607606

Declaration

As a participant in this study I understand that:

- My participation is voluntary, I am not being forced to take part in this study
- I may withdraw from the study if necessary
- I may refuse to answer any questions during our talks
- Anonymity will be guaranteed at all times- I will not be required to reveal my name and that in photographs that are taken my face will not be revealed but will be "blackened out"
- Confidentiality will be guaranteed at all times, What and how I teach will not be reported to other Life Sciences

I_____ hereby confirm that I understand the contents of this document and the nature of this study. I consent to taking part in this study.

I understand that I am able to withdraw from the study at any time, should I wish to do so.

_____ _____

Signature

AnnexureD2- Anecdotal images

On route to deliver questionnaire to the Life Sciences teachers I received anecdotal incidents from the first teacher. Hence it became necessary for me to record all this information that was I was being bombarded with. I entitled these journal entries anecdotal images as they mirror exactly what occurred.

Anecdotal image 1

The first school I had stopped at to deliver a questionnaire to the Life Sciences teacher was Havenwood secondary school. I had arrived at the school during the beginning of the interval break and made my way to the admin block to meet the principal. The admin block is parallel to the staffroom. Before I could reach the admin block the HOD for mathematics and science came out of the staffroom to meet me. I greeted the HOD and she **(Line 5)**
informed that Mr.P.Q had resigned from his teaching post and was no longer at this school. I had visited this school on many occasions previously to moderated portfolios and provincial exam scripts. During these visits I interacted with Mr. P.Q. and the HOD was aware of this. The HOD hurried on to explain that PQ's resignation is a loss to the school as he was a seasoned educator and assisted the school with fund raising, sports, **(Line 10)**
and academic ventures. What is strange and difficult to understand according to the HOD is that Mr. PQ has resigned from Haven wood and is employed by the SGB of Forestvista secondary which is 2 km away from Havenwood. I enquired what reasons PQ gave you, for his resignation, you were his HOD and you had to work closely. The HOD was unable to explicate the reasons for PQ resignation. I enquired who had replaced Mr. PQ **(Line 15)**
and the HOD stated that they have a new male teacher who is very young. She went on to explain that he had taught at a primary school prior to this appointment. I asked does that bother you, she replied off course it does. He has no experience teaching Life Sciences and has never taught senior classes before. The buzzer was sounded to mark the end

of the interval break and the beginning of the third period. I asked the HOD if it was **(Line 20)**
possible for me to meet the new Life Sciences teacher. The HOD stated she will escort me to the laboratory. En route the laboratory I explained to the HOD the nature of my study and also showed her the letter from KZN Provincial DoE granting me permission to conduct research in the Phoenix North region. I was introduced to YS the Life Sciences teacher by the HOD and the HOD took the liberty of informing YS about my **(Line 25)**
study. YS indicated that he would be glad to be a part of the study and that it was the first time he will be participating in a study. I made arrangement with YS and HOD to have the questionnaire picked up a week later **(Line 30)**

Anecdotal image 2

The next school on my route of questionnaire delivery was Forestvista secondary. As I entered the school gate I was met at the gate by the principal. We greeted each other. I told him about the purpose of my visit. He told me, there was no need to explain any further as he was in favour of any research that will benefit education and it was not a problem for me to see Mr. PQ. The principal asked me to find my way to the lab. I had also visited **(line5)**
this school on many occasions previously and knew my way around the school. The principal wished me well with my studies and informed me he was on his way to a meeting at the district office. I made my way to the lab and found PQ busy setting up an experiment. The lab was empty. I greeted PQ and enquired about the empty lab. He stated that it was his free period and he was setting up experiments for his grade **(line 10)**
10 and 12 lessons. I told him about my visit to his previous school and that the HOD was really sad that he had resigned. PQ responded that he had resigned as he wanted better working condition, he was frustrated with the high levels of expectations of teachers that HOD's, principals, Subject advisors, parents have of educators. I asked him why he did not apply for a transfer instead of resigning. PQ informed me of the moratorium **(line 15)**
placed by DoE on teacher transfers and the subsequent withdrawal of the document that advertised all teaching vacancies. He said that the only option available to him to escape poor working conditions was to resign. I enquired about the implications this would have for him financially. PQ stated that sometimes it's necessary to cut ones losses and move on in live rather that stagnate and be unhappy and disgruntled. PQ stated that being **(line 20)**
a SGB appointee meant that he only received a salary with no benefits e.g. medical, pension, housing allowance etc. I enquired how working condition could be better and how expectations are different just 2km down the road from his previous school. PQ responded that the working conditions were better at this school, he was given the latitude to be the expert in his field, he could drive and design the learning process as he **(line 25)**
saw fit to meet the needs of the learners. He did not have to follow what was prescribed across the board by management. There were more resources at this school in terms of practical work and funding available for purchase of specimens etc. Learners were better behaved as the management had a strict discipline policy in place. This discipline policy was adhered to in serious and uniform manner. PQ went on to explain, that in his **(line 30)**
previous school the school discipline policy was a formality that existed in paper. The policy was not upheld by the management. Teachers were expected to enforce the policy without the support of the management. PQ explained that this really got to him as it impacted on teaching and learning. PQ explained that the SGB of Forestvista was very supportive of staff and they shared the responsibility of fund raising and assisted **(line 35)**
with extra curricular sporting activities in terms of coaching, transport, umpiring. PQ responded that these factors allowed him the space to focus on his job, which was to teach learners. PQ added that the management style at this school was different from his previous school. I enquired how the management style was different as both school were under the control of the same SEM. PQ responded by saying that on paper the management **(line 40)**
plan could appear to be the same but the attitude, personalities and the style of interaction of the management was at opposite end of a continuum. I then asked about how the expectation for him had changed now that he had moved to another school. PQ stated that in Forestvista the management is very supportive, he is treated with respect and dignity, his opinions on Life Sciences as a learning area mattered to management. This **(line 50)**
motivated PQ, to promote Life Sciences amongst learners. I responded that I was glad that he was happy at his new school. PQ stated having the correct working environment was important to him. PQ told me, his wife was also happy that he had moved away from his pervious school as he did not complain about school and its "politics" anymore, he was more relaxed. PQ went on to explain that in terms of parents, the SGB at this **(line 55)**
school always acknowledges how hard educators work and that they (SGB) are aware of all the addition demands make up educators. I commented that it was good to know that the SGB were taking their responsibilities seriously and assisting with the roles designated to them. When I asked PQ how the expectations of subject advisor had change. PQ laughed, and responded you've been away for too long do you honestly think they can **(line 60)**
change their expectations of us or their interaction with us, you known that they have different "strokes for different blokes". They (subject advisors) continue to expect us to produce a 100% pass rate with many A's. They are really out of touch with reality. They don't know how things are at school or how schools and learners operate these days. PQ stated that there was a dire need for Subject advisors to return to the **(line 65)**
classroom for a period of time so that they can know how we experience teaching and how we battle to implement all the fancy ideas that they have. I responded so you want the subject advisors to take a reality check, do you think this will help teachers? PQ replied that it will definitely help us, on condition that we don't send them to ex model C school but send them to ordinary state school that lack resources. PQ asked me, have you **(line 70)**
forgotten about the graphs the subject advisors distribute to us at our first meeting at the beginning of each year. I stated

that I vividly recalled those graphs and the sermon that went along with it. He went on, you know how embarrassing and humiliating that can be if your Bio results are not good. He went on to explain, some of us experienced that often when our results were "not good". PQ enquired , have you forgotten the **(line 75)**
size of their ego's, and how they "crow" about the outstanding results their regions produce. PQ continued they (subject advisors) make it seem like they were responsible for teaching those kids. **You know that we are under tremendous pressure to (line 78)**
produce good results by the subject advisors, SEM, principals, parents. We are judged by the results we produce in terms of our IQMS ratings, if the results are good they are good managers if the results are not up to expectation we are poor teachers. I told PQ about my study and he readily agreed to participate in the study **(line 82).**

Anecdotal image 3

The next school on my questionnaire delivery route was Forestview. I arrived at the school and made my way to the reception area. At the reception area I met the SGB chairperson Mr. B. He recognised me immediately, as I had taught his daughter and son at my previous school. He enquired about my studies and when I was going to return to my school. I responded that this decision rested in the hands of the KZN DoE. The deputy **(line5)**
principal emerged from his office and welcomed me to the school. I explained the nature of my visit to him. He responded you don't need to be escorted around our school, you know where to find NC (the Life Sciences educator). Upon entering the lab I saw NC was busy teaching a class of six learners. He was happy to see me and set the class a task before we could meet. The first thing he asked me was: did you see the size of my class? **(line10)**
He continued before I could respond, even Crawford class size are larger than this**.** NC complained bitterly that the number of students doing Life Sciences is decreasing. I asked him why the number of students doing Life Sciences decreasing. He responded the Life Sciences curriculum is too challenging as compared to for e.g. TT where less demands are made on learners in terms of content. I asked how the Life Sciences curriculum is **(line15)**
too challenging. He stated that the Life Sciences content is difficult, too in-depth, too voluminous and beyond the grasp of many learners. He went on to explain that another reason for the decrease in students doing Life Sciences is related to the PPN (post provision norm) teacher pupil ratio. This ratio is calculated for each school in KZN by the provincial DoE. The PPN value assigned to a school tells us how many teachers the school is **(line 20)**
entitled to have. This figure is inclusive of the principal, deputy principal, HOD's and educators. The PPN is based on the tenth school day enrolment figure of learners. The PPN actually determines the allocation or teaching loads of teachers. Teachers holding different post levels within a school have different teaching allocation. In calculating this ratio DoE does not take into account the different teaching loads for the different levels of **(line 25)**
educators. In the calculation done by DoE all educators are expected to carry an equal amount of teaching periods. However this is not a reality in our schools. Principals have fewer teaching periods, followed by deputy principals, HOD'S and then level one educators. In other words level one educators have to carry the burden of having more teaching periods. This has implication on staff allocation. We find that often **(line30)**
teachers who cannot make up teaching load in their trained learning area are forced to teacher other learning areas to make up their teaching load. In most cases subjects at a grade 8 and 9 level are considered to be filler that are used to fill up the educators teaching load. These educators are not "skilled/ trained" to teach for e.g. Natural science or math in grades 8 and 9. These teachers view e.g. NS as a "filler and a killer" subject **(line 35).**
This colloquial description means that the teacher teaching these "killer and filler" subjects do not take these subjects that are included in their allocation seriously. Hence learners loose interest in for e.g. science and do not select Life Sciences in grade 10. NC continued and voiced his dismay that Life Sciences teachers have become marginalised and are not even considered for the post of HOD in schools. He went on to explain how the **(line 40)**
HOD post for the following learning areas were combined due to a lack of funding, Mathematics, natural science (i.e. biology, physical science, natural science) and computer science. NC cynically responds that these learning areas are identified as key learning area by national and provincial DoE for the development of our youth. In most schools the HOD post is allocated to educators within the Math learning area as **(line 45)**
Math is perceived to have a higher status as compared to Life Sciences. NC went on to explain, another reason for the decline in students doing Life Sciences is that learners have great difficulty in reading and understanding the language of science. I asked what do you mean by this. NC replied, Biology has is own vocabulary and language, learners find the terminology difficult to comprehend. The wording of questions are not straight **(line 50)**
forward, learners have to deconstruct the question, many times, before they can answer it. I (NC) find that DoE with its curricular demands now denies access to learners in Life Sciences instead of broadening access to learners into the sciences. He went on to say, this is really sad as the government on one hand wants to promote the sciences amongst our learners yet its very policy is making the subject less accessible. I replied that his **(line 55)**
concerns are very valid. NC stated that Life Sciences has become a Subject for the academic elite student and was taken by student who hoped to pursue science at university. I told NC about the purpose of my visit and he replied that he will participate in my study.

Anecdotal image 4

I arrived at Woodvista secondary and made my way to the reception area. The principal was in the reception area chatting to the RCL executives. He introduced me to the learners and asked them to come and see him during the lunch break. The principal enquired about the Project that I was seconded to and how far my studies had progressed. I informed the principal about the goals of the Project and the conference hosted by the project. **(line5)**
also told him I was currently capturing data for my study and that was the major reason for my visit to his school. He said that I was most welcome to collect data at his school. The principal expressed his disappointment with the resignation of two Life Sciences educators at his school. He stated" I know that they are you're pals" and that you have worked closely with them for many years but I am just so upset with them. He stated **(line10)**
that RG had already resigned and had taken up a GB post at another school and DM had placed his resignation in and would be finishing off at the end of March. The principal enquired if I would like to take up the Life Sciences post at his school. I responded that I am happy with my current position. The principal told me to find my way to DM's lab. When I got to the lab DM was busy in the anti room fetching apparatus for his **(line15)**
practical lesson. I greeted him and he started informing me on the latest occurrences in our region in respect of the Life Sciences teachers. DM told me about RG's resignation and told me that he had also placed in his resignation. DM is a seasoned matric Life Sciences teacher. I enquired about the reason for his resignation. DM's reasons for resigning include too much admin work, less time for content, sick of autocratic nature of Subject **(line20)**
Advisors in Life Sciences, **they lack an understanding of the dynamics of a school in terms of time available for teaching. On paper, DM stated, it may seem there is enough time but our lessons are often curtailed to complete forms, fund raise, for sports, debates, attend to social/welfare problems, attend meeting over weekends. I enquired about the social problems he referred to. He responded that House Parties are the in thing in this area, they drink and get stoned, we (line25)**
often have to call the police to deal with high levels of absenteeism on certain days, We must counsel them, cover up the work that they have missed and make arrangement for them to do community service. It is such a waste of valuable teaching time.. It is just to risky to go to these house parties by ourselves we always call the police to accompany us. I asked so why do they go to house parties? DM replied to have fun, drink and get **(line30)**
stoned, he continued, you will be shocked at the compromising situation in which we find the learners. You know, we are still faced with dealing with these learners when they return to school. We must counsel them, cover up the work that they have missed and make arrangement for them to do community service. It is such a waste of valuable teaching time. They (DoE) should never have done away with guidance counsellors at **(line40)**

our schools. This scenario occurred in ex HOD and ex HOA schools due to DoE's Rand R policy. The R and R policy required that certain post held by teachers in certain learning areas be rationalised and that these teachers should be redeployed into other learning areas or other schools in other region**.** We are also expected to excel in all fields, and provide as many codes of sport as possible so we can attract the best and more **(line 45)**
students at all times**.** I asked why would they want to attract more students. DM replied you know this is a numbers game amongst the principals, so they can increase their salary notch if the number of learners pick up significantly. We do all of these activities without being reimbursed, we go for sport, meetings, and take learners to co curricular activities. He went on to explain that it was sad that teachers are not valued for all that they do. It **(line50)**
seems like parents, managements and DoE take teachers for granted responded DM. You are just a number that can be replaced so easily. Dm is resigning to open a health parlour. DM enquired about my studies. I explain to him the purpose of my visit. DM agreed to participate in my study. I left a questionnaire with him and made arrangement to collect it in a week. **(line55)**

Anecdotal image 5

I took a detour from my questionnaire delivery route and decided to stop at Sastriview High. I went to the reception area and requested to see the principal. I met the principal and told his about the reason for my visit to his school. He told he would get the admin clerk to escort me to MR. RG's lab. RG was a "seasoned" Life Sciences teacher with 18 years of teaching experience at a matric level. When I reached the lab RG was busy**(line5)**
teaching. The lab was well resourced with state of the art equipment. He set the class some work and we met in the junior lab which was not in use currently. I informed RG that I had been to his previous school. RG immediately began explaining the reason for his resignation. He said he was happier at this ex model C school as a SGB appointee. He was sick of being over worked, there was no chance for upward mobility **(line15)**
(promotion) as there are no vacant MSC post (maths, science and computer) available. Resignation was currently the only way out to escape being over worked as there was a moratorium on teacher transfers. I asked how his work load had changed as he was still teaching. He replied that he no longer had to contend with fund raising, sport duties, counselling, admin work such as collection of funds, running out **(line20)**
worksheets, typing exam papers and tests. RG felt he was not appreciated by his previous school. I asked how come you were not appreciated when you produced a 100% pass rate for the 5 consecutive years and was actively involved in all

co curricular activities. He replied that the management did not appreciate teachers who always question management motives and decision making, you know that they prefer the "ja baas" type of**(line25)**
teachers and I was not prepared to be that type of teacher. RG went on to say Subject Advisors, have high expectations of Life Sciences educators in certain regions only –they do not have the same expectations for all educators, we are under constant pressure to conform to the requirements of Subject Advisors- they expect NCS FET Life Sciences curriculum to be followed to the T, **they are oblivious to the other demands made(line30)**
on us e.g. sport, fund raising, admin, relief, marking the register, Collection of funds, coping with social problems of learners, we are counsellors, welfare workers, police to students and parents. They do not see the time constraint we are faced with on a daily basis. They see this curriculum unfolding from their offices in Pretoria and Truro house with no interruptions to our teaching time. We have never been a part of the **(line35)**
development of the curriculum so how can we be expected to share in the vision of this curriculum. You tell me if it's possible to be a part of a vision if you have no say in it and do not share in the same vision. These subject advisors have been out of the school situation for far too long. It's easy for them to stand in front during the training
session and tell us how to implement the curriculum but we would rather have **(line40)**
a practical demonstration "a show and tell "of how it to be done in our classroom. You know nothing has change they have not improved this silly training session from OBE days. What we truly need during these training session is a someone to demonstrate this is how you cover this section and this is how you address the LO's and AS'S for this section, that's what we need, we are all familiar with our historical background so when **(line45)**
they plan the training session I would like to know what inform their planning do they make use of research or is it a pie in the sky dream. RG stated that he would love to challenge any one of our subject advisors to teach in our schools for one term. He asked me do you think they will survive for a term. I responded that could be a trying situation for Subject advisors, learners and management. He said and then there is IQMS and **(line50)**
you know how that works, how some staff members will "scrape" with the office to get a high score. IQMS (integrated quality management system) is a system of appraisal introduced in our schools. People at the top (DoE) don't see the bigger picture, every time there was a new minister of education there was a **(L54)**new policy. you know we are not lazy but we are complaining, we have no say in these matters, yet they expect us to share their vision for curriculum implementation, this NCS FET Life Sciences curriculum is being revamped and we will be teaching new curricula's in 2009, 2010 and 2011, so where's the opportunity to get used to teaching the curriculum if it changes so often and we must be trained again and again Every time there is a new policy we have to be retrained, we get "deskilled" and "reskilled". This is very **(line59)**
confusing and unsettling. We just start adjusting to the "new policy" and its time for retraining as another policy has been introduced. RG asked do you honestly think this is not fair to us. I responded that this was certainly not fair on teachers. RG responded you know this impacts on our workload we now have to prepare and develop new learning materials, lessons, assessments. This is really frustrating, you know we are not lazy but **(line60)**
we are complaining as we have no say in these matters. RG went on to say this NCS
FET Life Sciences curriculum is being revamped and we will be teaching new curricula's in 2009 to the grade10 learners, 2010 to grade 11 learners and 2011 to grade 12 learners. He complained so where is the stability for us, how can we gain confidence teaching/ implementing the curriculum if the curriculum is changed every three years. I**(line65)**
asked would you like to have a say in policy development. He replied yes, I would. He continued, I can make a contribution to the content that should be included from an informed perspective, I have been working with these curricula's for years and I know what works and what doesn't work. We currently have a top down approach and I don't like this approach. Further more, RG continued, DoE should get personnel who are **(line70)**
very competent to conduct the training session. RG asked do you recall our first FET training session at Spes Nova. I replied by just nodding my head, he continued that lady facilitator didn't know how many AS's there were and you had to tell her what each AS involved. RG enquired how my study was progressing. I replied that I was at the stage of data capture and that was the purpose of my visit. RG state that he will take it as a personal affront if he was not a part of my study **(line 76)**.

Anecdotal image 6

I reverted back to my original plan of questionnaire delivery. I arrived at Grovehaven secondary. The principal and deputy principal were not at school I met the MSC HOD. The HOD enquired about my secondment and my study. The HOD at this school is a relative of mine. I told the HOD that I was enjoying my secondment and that I was at the data capture stage of my study hence the reason for my visit. He stated that I was welcome **(line5)**
to collect data at the school and that I could visit the teacher I needed to see in her classroom. The HOD informed me that the Life Science teacher had handed in her resignation and was due to finish off at the end of the first term. He also informed me that the computer studies teacher had also resigned and that three other teachers were considering resigning as a result of the moratorium placed on teacher transfers. **(line10)**
I enquired has teaching become so bad. He responded it seems like it has. En route to BB's classroom I met many colleagues. They all looked overworked and tired and the classes were crowded with learners. There was hardly any space for the teachers to move around the class to supervise learners work. When I reached BB'S class she was teaching Maths literacy to a grade 10 class. She was excited to see me. She set the class their **(line15)**

homework and asked them to begin the home work in class. This class had about 55 learners. BB'S informed me of her resignation. I enquired why she had resorted to resigning. BB's stated that her work load was to great, she receives no support from the management, the management is autocratic, she has no access to the labs even though the school has equipped lab. I asked her how this was possible when nationally and **(line20)**
provincially there is an outcry for learner to have access to labs, and that concerted efforts are being made to develop labs in previously disadvantaged schools. BB's stated that this was a decision made by the upper management (Principal and deputy principal). BB stated that the upper management was of the opinion that discipline will improve learners if learners were to remain in class the whole day. What is so frustrating is that **(line25)**
they expect me to carry all the apparatus that I will need for the day from class to class. This is not possible, who is to be accountable for stock that goes missing or any accidents that occur. I added that it is also very dangerous to be transporting chemicals and apparatus from class to class. Even W.W. our SEM is blind to this fact, our labs have not been used, they are white elephants. We have been ousted out of them by the management, **(line30)**
can you believe our principle is a science person? BB continued that Life Sciences is a very interactive subject, you know that better than any one, she continued if I am in the lab and a student does not grasp a concept I could dash in the anti room to get for e.g. a slide or model to enhance my explanation. What is amusing about this issue of teachers moving from class to class is that the deputy principal and principal have **(line35)**

class rooms allocated to them and learners move to these classes. It when learners are moving to these classes that we experience discipline problems. These learners are often left unattended as the principal and deputy principal are engaged with admin duties. BB went on to say you know an idol mind is a devils workshop. I enquired has the staff not brought this to the attention of the upper management. BB went on to say staff **(line40)**
was fed up with the autocratic nature of the upper management and that there was not much staff could do to address this issue. BB explained that staff was afraid of being victimised, as this seemed to be the modis operandi of the upper management. BB went on to explain how members of staffs were reprimanded for trying to seek assistance from the union and SEM to intervene in the victimisation met out to them. **(line45)**
BB went on to say that Life Sciences as a subject is dying, to few learners are taking Life Sciences. I enquired why Life Sciences was considered to be a dying subject .BB responded that other subjects are more appealing, content not voluminous like Life Sciences, these other subject are less demanding, Life Sciences is seen as difficult subject , pass rate in Biology not like other subjects- fewer A at Matric level in nated **(line50)**
system , so reputation of Biology is tarnished. Attitude of learner is" Why suffer when I can do the minimum amount of work and get an A in other subjects". I responded that I was aware of the fact that the number of A's in biology at matric level was lower than in other subjects for e.g. geography. BB went on to say I am teaching 3 learning areas in FET phase, this again is a unilateral management decision, I am tired of trying to get **(line55)**
them to see the need for the development of specialised SKAVs in these learning areas. It is really very frustrating, I have no personal time. I am always busy trying to develop lessons, assessment etc. This is impacting on my personal time with my family. With IQMS we are under pressure to perform at all time, we are told in a very subtle manner by the upper management our contributions to the co operative life of our school are under **(line60)**
observation. I used to love teaching but now I can safely say the admin work, autocratic management and bureaucracy associated with teaching has destroyed my spirit and passion for teaching. BB then apologised for not having asked me the reason for my visit. I told her about my study and she immediately responded that it would only be a pleasure to be a part of this study. BB reminded me that her services will be over at the end of the first term. **(line70)**

Anecdotal image 7

I drove to Avonmore secondary. In the car park I met the Senior school clerk, Mr. B . He informed me that he had just returned from the bank. We both made our way to the admin block together. He told me that Ms. SN ,the life sciences teacher, has placed in her resignation and was not in school today. He **(line 3)**
wanted to know if I had come to see her. I told him I had come to see SN and BP with regard to my study. He responded that **(line5)**
BP will retire this year but she was in school today. He could see the questionnaire that I had and inquired about them. I told him that I was delivering questionnaire to Life Sciences teachers in our region for my study. He asked are you going to drive to all the school in this heat? I responded yes. He continued there is a Life Sciences meeting tomorrow at MVS and you could go to the venue before the meeting starts and hand out the **(line10)**
questionnaire to the teachers. He said you will save time and you will get to meet most of the teachers at this meeting. I thanked Mr.B for this information. Upon reaching the admin block I encountered BP. BP was busy reprimanding a learner who had vandalised the science class work desks. This learner had taken typex and written his name and had drawn vulgar pictures on the work desk. BP is an HOD at this school and assists the**(line15)**

management with discipline issues. She was horrified with this learner and reminded him that a desk costs the school about R550.BP asked MR. B record the pupils name in the defaulter's book and hand the learner a letter for his parents to call at school. BP informed me about her forthcoming retirement and how she was looking forward to it. BP had been teaching for 35 years. BP enquired about my secondment and asked if I would **(line20)**

want to replace SN. I replied no and told her about the purpose of my visit. She said that she will take a questionnaire for herself and SN. I made arrangement to collect the questionnaires at the end of the week. **(line23)**

Anecdotal image 8

I arrived at MVS car park at about 7:15. At different parts of the car park there were little pockets of teachers who had congregated to chat with each other. As I moved towards the first pocket of teachers ER shouted out "Are you back with us, please tell me you are going to set the controlled test paper so I don't have to worry about it." I greeted ER and the 7 other female teachers who were with her. I asked is this a ladies exclusive **(line5)**
meeting. PM responded of course we are discussing men-o-pausal issues. There was a roar of laughter. BJ was quick to tell me, in a serious tone, that today they were going to have a meeting to discuss the 2007 grade 12 results in our zone and to set up cluster committees to set the controlled test papers. CR asked, have you come to collect the graph for your school to check if your replacement has done a good job. Everyone burst out laughing. **(line10)**
I replied that graph was already collected, it framed and was hung in the school corridors. There was more laughter. I told the group about the purpose of my visit and CR volunteered to collect the questionnaire from the 7 educators. CR informed me that she is a newly appointed CASS moderator and she will be meeting with the educators during the course of next week. CR stated that she will remind the educators to bring to **(line15)**
questionnaire with them when they attend the meeting at her school. I thanked CR for volunteering to collect the questionnaires but told her that I preferred to collect the questionnaire from the educators myself. I made arrangement to collect the questionnaire from the educators in a week's time. I apologised for not having more time to chat with them and moved on to the next little pocket of teachers.I recognised **(line20)**
RG, DM, KS in this group of educators. When RG saw me approaching the group he said "people check who's coming to see us". I greeted this group of 15 teachers (males and females). PS asked in a serious voice are you back at school. RG responded teasingly, do you think she is mad to go back to that school. DM added can't you see she has come with application forms, she now recruits people for me. PS, looking very confused, **(line25)**
asked are you working for DM now. Everyone laughed. KS responded, don't you know that she has been seconded to the national office as KN's personal assistant. There was more laughter. RG chipped in, hey guy, PS might ask SC and GP if what we said is true. RG continued PS we are "pulling you leg" AP is seconded to a project and she don't work for DM or KN. PS responded you guys are always doing this to me because**(line30)**
I'm a " ballie" (old man). I responded don't worry about them you are outstanding teacher. I congratulated PS for having had a learner obtaining 100% in the national senior certificate grade 12 biology examinations in the 2007. I also reminded the group that PS had taught me at school. PS responded proudly, you can see "the product" of my hard work and where she is today, you guys know that I have taught her son and now I am **(line35)**
teaching her daughter. PS continued I feel proud to know that my ex pupils are forging ahead in their career paths. PS went on in spite of all the stresses we have to deal with in our job, our merger salary and the abusive comment often directed to us by the public when we go on strike I still find teaching rewarding. PS continued, I feel we are making an invaluable contribution to society. PS went on it is such a good feeling to know **(line40)**
that we can make a difference in the learner's lives. RM cut in, PS don't get "mellow dramatic" now AP tell us why you came to see us. I quickly explained about my studies and the purpose for my visit. I issued 12 questionnaire and made arrangement to collect them in a week's time. **(line44)**

I moved on the next group of teachers at the far end of the car park. This group was very large and consisted of about 32 teachers. These teachers were busy caucusing to elect a new regional chairperson for the Life Sciences subject committee. I greeted the group and apologised to intruding their meeting. SM stated in was not an intrusion at all. Many teachers in this group asked in unison if I was back at school. I replied not yet. We **(line50)**
observed the Subject advisors arriving at the car park. I told the group about the purpose of my visit and they agreed to participate at the first level of the study. I hurriedly handed out the questionnaire and made arrangements to collect them in a week's time. It was 8:30 and time for the meeting to begin. I left the car park. **(line54)**

Table: Synthesis of Anecdotal – journal entries

Theme	**Snapshot 1**	**Snapshot 2**	**Snapshot 3**	**Snapshot 4**	**Snapshot 5**
Teacher resignation	**No transfer Moratorium policy**	**No transfer, Moratorium policy management style**	**-**	**Management style, multiple role of teacher**	**No transfer, Moratorium policy work loa management style**
Teacher migration	**Better working conditions**	**Better working conditions**	**-**	**-**	**Better worki conditions**

Stakeholder expectations		**Subject advisors, SGB, principal, HOD**		**Subject advisors, parents, DoE**		**Management,**
Policy documents		**Discipline policy**	**PPN, teaching load, no of learners decreasing, promotion post combined**	**Rand R- no guidance counsellors**	**PPN, no promotion, IQMS, reskilling and deskilling of teachers**	**IQMS, PPN,No of learners decreasing,**

Annexure D3

Life Sciences Teachers Questionnaire

1. Did you attend any training sessions conducted by subject advisors/ facilitators to be able to implement the NCS FET LS curriculum at school?_____

2. What was the duration of this training session?_____

3. Did this training session give you a more informed view about the syllabus, content, depth of content to be covered, etc?(please give reasons for your answer/s)_____
_____

4. The NCS FET Life Science curriculum covers aspects of Biotechnology from Gr 10 to 12. What SKAVs do you focus upon/aim to develop in learners during the teaching these sections when engaging with the Life Sciences curriculum and why?

Skills_____

Knowledge_____
_____

Attitudes_____
Values_____

5. Do you have ample time to engage with the content, focus on the 3 learning outcomes and the assessment standards and develop SKAVs in learners as suggested by the NCS FET LS curriculum? (please elaborate)_____
_____

6.1.Does the NCS FET LS curriculum focuses on SKAVs that will assist learners to enter the world of work in industries that use the application of Biology and/or Technology ?Kindly elaborate your answer.
_____

6.2. If you answered yes to 6.1. above , please list the SKAVs you think prepares learners for the world of work in industries that use the application of Biology and technology._____

Annexure D4: Analysis of questionnaire responses

Q1.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	6	13.3	13.3	13.3
	yes	39	86.7	86.7	100.0
	Total	**45**	**100.0**	**100.0**	

6/45 (six out of 45) did not attend training, 39/45 did attend training

Q2 Duration of this training session

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Attended training for one week	34	75.6	75.6	75
	Attended training for 3 days	1	2.2	2.2	77
	Between 6 to 1.5 hours	4	8.9	8.9	86
	Attended training for 0 hours	6	13.3	13.3	100
	Total	**45**	**100.0**	**100.0**	

34/45(34 out of 45) attended training for one week**;** 1/45 attended training for 3 days, 4/45 attended training for 6-1,5 hrs, 6/45 did not attend any training

Q3 Did this training session give you a more informed view about the syllabus, content, deptl content to be covered, etc?(

		Frequency	Percent	Valid Percent	Cu P
Valid	No comments	6	13.3	13.3	
	Found training adequate	4	8.9	8.9	
	Found training satisfactory	2	4.4	4.4	
	Found the training confusing and there were to many text books -no specific textbook was recommended	8	17.8	17.8	
	Training did not concentrate on depth, LOs to be covered with examples	18	40.0	40.0	
	Training session consisted of too much information to grasp at once	3	6.7	6.7	
	Found the training to be good	1	2.2	2.2	
	Training provided no clear guidance on content depth, exams, text books, assessment	3	6.7	6.7	
	Total	**45**	**100.0**	**100.0**	

6/45 no comments (these six individuals did not attend the training) , 4/39 found training adequate (10.2%) **;** 2/39 found training satisfactory(5%) ; 1/39(2.5%) found the training to be good ;8/39 found the training confusing and there were to many text books –no specific textbook was recommended(20.5%)**;** 18/39 training did not concentrate on depth, LO's to be covered with examples(46.2%) ; 3/39(7.6%) training session consisted of too much information to grasp at once ,**;**3/39(7.6%) training provided no clear guidance on content depth, exams, text books, assessment in effect 32/39 found the training to be unsatisfactory

$Q4_Knowledge

		Responses	
		N	Percent
$Q4_Knowledge[a]	As per curriculum	29	53.7%
	Concepts	2	3.7%
	Understanding terms	3	5.6%
	Genetics	2	3.7%
	IKS	7	13.0%
	DNA information	11	20.4%
Total		54	100.0%

a. Group

$Q4_Attitudes

		Responses	
		N	Percent
$Q4_Attitudes[a]	Positive attitude	9	18.0%
	Open mindedness	10	20.0%
	Appreciate IKS	5	10.0%
	Tolerance	8	16.0%
	Respect	5	10.0%
	Responsibility	4	8.0%
	Sustainability	9	18.0%
Total		50	100.0%

a. Group

Graph

$Q5 Frequencies

		Responses	
		N	Percent
$Q5[a]	Syllabus too long	23	35.9%
	Burdened with other compulsory duties	18	28.1%
	Time cut for fund raising, sport, department stats returns	10	15.6%
	No clear guidelines on actual depth to be covered- cannot do justice to content and all LOs and ASs	13	20.3%
Total		64	100.0%

a. Group

Q6.1.

Does the NCS FET LS curriculum focuses on SKAVs that will assist learners to enter the world of work in industries that use the application of Biology and/or Technology	No.	Total percentage
Yes	26	
No	12	
Limited extent	1	
Not sure	6	
total	45	100

Q6.2.

list the SKAVs you think prepares learners for the world of work in industries that use the application of Biotechnology	Number	Percentage
critical thinking	7	
Problem solving	16	
investigative skills	12	
group work	3	
team work	2	
analysis of data	13	
diseases/medical world	10	
genetic engineering	5	
sustainable living/IKS	3	

Annexure D5

Observation of policy implementation transcripts

PVS (2 lessons)

The PVS is a coed school in KZN, South Africa. PVS is situated within a predominantly Indian community and is surrounded by homes that form the lowest rung of the property market. The school is encircled by a 2.5. meter concrete palisade fence at the gate there is a guard. It was 7:20 and learners clad in uniform and school tracksuits were walking bristly into school. The learner population comprises of 70 % Indians, 25% Black South Africans and 5 % foreigners (African and Pakistani) The deputy principal, RN, was at the gate waiting to meet late comers. The school garden is neat, free of liter and well manicured. The school building is old but it is not defaced with graffiti. A halo of neatness, regiment discipline and pride engulfs PVS. Teachers were in school before 7:30. I was met by the second deputy principal, SR and escorted me to the Lab. SR informed me that the school fees was R600 p.a. and the recovery rate was very low as unemployment was high, people lived in abject poverty thus extensive fund raising had to be done by teachers. SR pointed out the CCTV cameras to me. I enquired about their purpose, to curb vandalism, drug abuse, protect our school property, teachers and learners, she replied. We've worked very hard to maintain our 100% pass rate in the matric exams, teachers provide additional tuition to learners over the school holidays at no cost. The outstanding matric results, extra tuition provided by teachers, various codes of sport offered are used to market the school and attract learners from grade 7 to PVS. Schools in this vicinity vie for learners. Discipline is maintained by the school code of conduct to which each learner and parent subscribes. If a learners defaults the school code of conduct parents are asked

to find another school for their child.

Enroute to the lab I passed the school library and noticed that a guest speaker was addressing G12 learners on career choices. I entered NK's lab before the arrival of the grade 10 learners. The lesson observed was of one hour duration beginning at 8:10.

The walls are covered with posters and charts on HIV/AIDS, mitosis, genetic engineering, DNA, cells, tissues. Models are displayed, the lab is well resourced. The charts, models relate to module one of the Life Sciences curriculum. Learners enter the room and wait to be greeted by NK. A practical investigation on leaf epidermis was conducted. Initially a question and answer technique was employed by NK to relate the learners prior knowledge on cells to tissues.

T: Good morning learners today you are doing a practical investigation on leaf epidermis

Rita what is a cell?

R: The basic unit of life

T: What do we call a collect of cells, Rayan

R: tissue

T: You have come across these terms when we were dealing with animal tissue, remember skin epidermis, what does the word epidermis mean? Yes Karen,

K : it is a covering tissue.

T: Good, you have remembered the work cover in animal tissue and relate it to plant tissue. I will demonstrate how to make a slide of the leaf epidermis, observe the stages carefully. You will work in groups and conduct an investigation on leaf epidermis and answer the questions posed in the practical worksheet. You are allowed to use your textbook to access information pertaining to the question .Remember, you have to state the aim of the investigation, write a few steps taken to conduct this investigation, draw a labeled diagram. In the exams your will be asked to state a hypothesis. A hypothesis is different from the aim, who can explain what a hypothesis is:

S: It is as testable statement and you don't know the results as yet

T: Good, remember you will be writing a provincial controlled test, you need to know how to state a hypothesis, draw graphs from the data given to you, Monitors from each group collect the materials required: microscope, slide, specimen, iodine, water, Petri dish, dissecting needle.

T: Please be conscious of the time, I will be collecting all pract reports at the end of the period.

Learners engage in group work. There is division of labour each learner engages in a activity- slide preparation, setting of microscope, collection of material, accessing information, completing worksheets individually. Teachers moves from group to group to assist learner. NK moved from group to group to provide assistance. NK used a demonstration and guided discovery technique to allow learners conduct the investigation. Learners were engaged in setting of microscope, making of slide, observation, recording of information, team work, presentation of information, clearing materials used during the investigation.

The atmosphere in the lab was relaxed and learners were working in a methodical and disciplined manner. Although learners were engaged in group investigation, they were not loud or noisy. There were 32 learners in this class. Learner's participation in the pre and post investigation discussion was spontaneously. In this lesson NK foregrounded microscopy competencies viz. observation, identification, slide making, group work, reporting skills (LO1, AS 1 and 2 covered, LO2, AS1 and AS2).

Examination of the teachers portfolio, lessons plans and assessments, revealed that learners were provided with multiple opportunities to master the LO's and AS's as per the mediation of policy and from the gazetted policy in the form of formal and informal assessments learners received. Reviewing teachers teaching portfolio file reveals that multiple opportunities are provided for learners to engage with LO1, LO2, LO3 and their respective assessment standards during the informal assessment. Informal assessment tasks are short and focus on a particular AS that the learner needs to master. The focus is mainly on LO1 hypothesis testing and planning investigations. The exams type questions are strongly foreground in all the informal assessment. Statical and diagnostic analyses are completed for each set of formal assessment given to learners. These analyses highlight the areas of weakness in a particular section/ topic. Learners are given comments on aspects that they need more practice/help in and are provide with remedial and extension exercises / activities. Opportunities were provided for learners and parents to comment on mark the learner obtained for each assessment. A closer look at NK's lesson plans revealed that the following techniques were used, demonstration, pupil investigation, group work, brain storming, debates, role playing, guided discovery, discussion, question and answer.

T: Class , please note that the test on Wednesday is to give you a chance to practice answering exams related question and manage your time, you will be writing a two and a half controlled test so you need to know how to manage your time. I will see you tomorrow and we will review your class exercise, Those of your who have not completed the class exercise ensure that you do. It important that you are trained well from now for matric therefore I expose you to exam type question and time constraints.

L: But sir we have so much of home work in all 7 subjects, and every teacher gives us work, I finish my homework every day at about 10 pm. Then we are forced to take part in the Debs ball and sporting activities.

T: Its these new curriculum that we have implement, we just have to cope and so do you. Remember to get your parents to sign and comment on your previous test sheet.

Lesson 2

SP's grade 11 lesson commenced at 9:10 in the same lab used by NK. The hands on investigation lesson focused on fungi. There were 42 learners in this class. Learners were expected to bring cultivated specimens of fungi for this lesson. SP used a question and answer technique to get learners to discuss the role of fungi in an ecosystem.

T: Ah I notice that you have all brought your cultures of bread mould, Good morning to you. That's healthy fungal growth your have Wasim, please ensure that the container in which the specimen is, is sealed. Those spores are dangerous if inhaled. Did you complete the little activity I gave you asking you to observe fungi in your environment?
L: Yes we did. I noticed fungi on decaying fruit, old bread, pickles, chocolate, roti, naan. **T:** I can gather that you have been observant. What role do fungi play in our ecosystem
L: Source of food, Decomposers returns valuable nutrients t soil.
T: Use the handlens to observe the specimen, then make a microscope slide and then compare fungi to terrestrial plants. Remember when making the slide less is more so remember to tease the specimen out so all structures are visible. While you will be sharing microscopes you will make your own slide, You need to know the techniques of microscopy as these skills will be used when you go to tertiary institutions and take science courses.

Learners were engaged in making slides, observation, identification, recording, drawing, three learners shared a microscope .The school did not have enough of functional microscopes as those sent to the DoE had not been repaired as yet. An opportunity for learners to engage in guided discovery was provided by SP during the lesson. Learners were afforded the opportunity to consult their next book to aid their discovery. Learners moved about freely amongst the groups but in an orderly fashion. Learners engaged in discussion within their group but were mindful of not making a noise or disturbing other groups. The following LO's and AS's were foregrounded in this lesson LO1- AS 1, 2, 3; LO2, AS 1, 2, 3.

Examination of SP's Cass portfolio, shows that the learners are provided with many opportunities to master LO1 competencies that were highlighted during mediation of policy. Statical and diagnostic analyses were done for each formal assessment task. The analysis was used to design remedial and extension exercises for the learners. In their test, investigations, class exercise, research project both the learners and parents were required comment on the learners achievement.

T: You have 10 minutes left to clear up, dispose all specimens in the bin, pack the microscope away, leave all repots on my work bench. Tomorrow I will be reviewing your class test, collect your test from me as you leave and get your parents to sign and comment on your performance. During the review I will focus on identification of variables, drawing of graphs. Remember hypothesis testing, translation of data, terminology are must knows for the exams. You have to score high marks, it will please your parents.

FDC school

Litter, empty and broken beer bottles, soiled sanitary pads, plastic shopping bags were scattered outside the periphery of the fence that surrounded FDC School. The top of the fence has razor wire. The school was nestled long side a highway and an industrial area. The school is situated along all taxi routes and is accessible to learners from Kwa Mashu and Brookdale. A guard was posted at the gate to the school and all visitors were required to fill in the visitor's book which contained information on name of visitor, time, contact details, name of person visited and reason for visit. A cleaner was mowing the lawn. The school garden was immaculate. The principal (LN) escorted me to the new administration block of his school. LN is a bubbly, enthusiastic, energetic principal who is passionate about his school and the teaching profession. LN reminded me that this is a combined school with learners from grade one to grade 12 with an enrolment of 1400.The learner population comprises of 69% blacks, 30% Indian and 1% other (coloured). The school fees are R550 per annum and the return rate is 33% we have to fund raise or our schools will eventually come to a stand still. The staff has to go "all out" (work very hard) during the fund raising ventures. The DoE has classified FDC as an advantaged school even though almost all the learners come from disadvantaged homes and communities. Poverty, unemployment, substance abuse is common in this area. LN explained the criteria DoE uses to classify schools as advantaged or disadvantaged. A school is regarded as being advantaged if the road leading to the school is tarred, the school has water and electricity and a brick building, if the road leading to the school is un-tarred or a gravel road the school is considered to be disadvantaged even if most of the road leading to the school is tarred. No consideration is given to the socio economic background of the community that the school serves. LN mentioned that KZN DoE had to return millions of rand that was designated for upgrading schools in the rural areas as enough tenders could not be obtained from the black construction companies so DoE decided to return the money instead of awarding the contracts

to those companies that applied. LN continued who cares if only Whites and Indian contractors tendered for the job, what has DoE done to empower people when it comes to a tender, filling off forms etc. All I'm interested in LN continued is that schools are upgraded in the rural areas so eventually we can all get the same amount of funding then only will the educational playing field be leveled. There is very little transformation or equity in practice everything is on paper. LN pointed out three vacant classrooms that could accommodate more learners at his school but they lacked furniture and teachers for these classrooms. FDC needed 10 more teachers. As we moved towards the end of the admin block I noticed that the learners were very well behaved and did not seem to be rowdy during the interval break. LN pointed out the feeding scheme run by the school for the Grades 1 to 7 which was funded by DoE. There were officially 350 learners from the primary section who participate in the feeding scheme and this number was increasing daily as learners from grades 9 -12 who are hungry come to eat. LN explained I can't turn theses hungry learners away, this is the only meal some of them get. The DOE expects principals to keep stats on a daily basis on the number of children who eat from the feeding scheme, teachers are already overworked with large classes, admin work, fund raising, extra curricular duties and going on duty during the breaks. The buzzer had sounded to mark the commencement of the 4^{TH} period. LN escorted me to the KK's class.

Lesson3: cell division- mitosis, meiosis

Focus LO: LO2- AS 1, 2, 3; LO3-AS1 and 2

The walls of the lab has relevant poster/charts related to module one on the Life Sciences curriculum- DNA, Cell, Mitosis, Biotechnology chart on Futhi the cloned cow. The classroom climate is relaxed, the easy going confident manner of the teacher allows for active participation of learners.

T: Look at this chart of futhi the first cloned cow, Dolly the first cloned sheep, now pay attention to this video of the movie "Look who's talking"- the scene depicts millions of sperm cells swimming towards the egg. The video recorder is stopped.

T: Name the process common to all three scenarios. Learners raise their hands and the teacher points to a learner.

Poppy: cell division, sir.

T: Correct my child, well done. Is cells division occurring in you?

Mohamed: Yes it is, it allows us to grow, repairs worn out and dead cell and allows for vegetative reproduction.

I: Sir, before you go on tell us how sperms how are formed, I didn't known they look like tadpoles or that millions of sperms are released into the vagina, or that they have to swim so far how do they do it, we can't talk about it to our parents?.

T: O k Isacc, there are two types of cells division, one occurring in ordinary body cells that produces identical cells with the same number of chromosomes- it allows for growth, repair, replacement of cells, asexual reproduction , this is called mitosis. The other type of cell division is called meiosis and it only occurs in sex cell, it producers 4 un-identical cells. The chromosome number is halved. Gametogenisis is the production of gametes, when sperms are produced in the testis this is know as spermatogenesis and when ova are produced in the ovaries this is know as ooogenesis. (teacher writes these terms on the chalk board as he speaks)

T: I want you to look at these models , these are 5 models for each group, that represent the different stages of mitosis, use you text book to help you identify each phase also note the distinguishing feature of each phase from the model before your and not the text book. I will give you 10 minutes for this, this means you have two minutes per model.

T: group two what is the distinguishing feature of the metaphase?

Bonga: The chromosomes are at the equator of the cell

T: Good observation group two, group one what is the distinguishing feature of the Prophase

Raesa: Chromosomes are visible

T: good, group 4 telophase

Sandra: Two daughter cell formed

T: well done that group now group one, anaphase

Andy: Chromatids are moving to opposite ends of the cell

T: Good, remember a good life sciences learner is always highly observant. Now that you know about cell division what is meant by cloning,

Poppy: It is making an identical copy of something like a cow, or organ

T: Do you thing cloning is a good or bad innovation, don't just say yes or no discuss this in your group and explain your stance when asked.

Jessica: I think its good, it can help us grow organs for organ transplant, you could clone yourself and there will be division of labour and each clone can have more time for leisure.

Tembi: Its bad, criminals could clone themselves and our crime rate would become higher, and we already have so much of crime in South Africa, maybe if we clone each police we will have more police men , the government could save on salaries and we could catch more criminals

Fana: Its not a natural process so its against my Christian beliefs. God created man, man was not created in a Petri dish.

T: OK I want you to write an essay on the ethics of cloning. You know that you have to write an essay in the exam. So take this exercise as practice in essay writing. I hope you are preparing for the controlled test. I am expecting good results from each of you it will show you how much you have understood during my teaching. Poor performance in test and a low Cass mark is unacceptable as it shows a lack of commitment to your studies. It also means that you do not understand my teaching. Remember there is just a week before you write the provincial controlled test. I hope you can state a hypothesis, identify variables, translate data know terms related to module one, give your views on the use of science and technology in our lives for example cloning, stem cell research, genetically modified foods. OK then class I will see you tomorrow and have those essays ready for me.

KK's interact ional style during the lesson facilitates understanding rather than rote learning. It was visible from the learners participation, rationale, lack of inhibition that these life sciences learners were always afford the opportunity to express their views on issues that affected them, technology, society, science and the environment. These learners could relate the content to their personal life. Perusal of KK's teaching portfolio file reveals that multiple opportunities are provided for learners to engage with LO1, LO2, LO3 in their respective assessment standards during the informal assessment. Ample opportunities are provided for learners to master hypothesis testing, planning investigations. Informal assessment tasks are designed to meet learners needs however the exams type questions are strongly foreground in all the informal assessment. Not all assessment are marked by the educator, peer and self assessment is also practiced. Learners are given comments on aspects that they need more practice /help in. Learners also provide feedback on how they found the task, what they need more practice in, learners plot a graph of the AS's they are familiar with.

MEIS

MEIS is a co ed independent private school that is situated on the boundary of a private golf estate. The parent's car

park is large and the school bus was parked in this car park. A number of learners were getting off the bus. As I approached the bus the learners greeted me, “good day miss”. The tennis court was being used by learners during their Life Orientation lesson. The buzzer sounded to mark the commencement of the lunch break (12:15 -12:40). I was met by the principal Mr. RB. RB drew my attention the school’s growth in terms of learner. The learner enrolment in 2007 was 280 and in 2008, 350 learners. The school fees range from R12 000 in grade one to R26000 in grade 12 and the return rate for school fees was 100%. The learner population comprises of Indian, white and blacks. MEIS does not need to fund raise thus teachers at this school only focus on teaching, extra curricular activities is conduct by a sport coach. The perks that attracted teachers to teach at a private school were no funding raising, no extra curricular duties and low teacher pupil ratios (1:15). This school uses its 100% pass rate in the matric exams, extra curricular activities, low teacher pupil ratio to attract learners. RB escorted me to the biology lab to introduce me to GVN the life sciences teacher.

Lesson 4 : Nucleic acids –DNA

Duration: one hour

The lab is very well resourced. Learners projects, models constructed are displayed, a rich variety of preserved specimens are visible on the shelves pertaining to Life Sciences, pot plant e.g. insectivorous plants, ferns, bryophytes are also found in the lab, experiments that were in progress(awaiting results) were situated at the rear workbench of the lab.

T: Hey, I marked your test, and I happy that you all have A’s. Now we need to improve the qualities of those A’s. Your parents pay a lot of money for you to attend this school so need to show them your appreciation by doing exceptionally well. Remember these controlled test marks are going to be used on your CAO forms for entrance into university .If your results are poor you will not be accepted into these institution- remember you have to compete with all the other learners in South Africa for these set number of seats that are available, don’t sit in your comfort zone and compete amongst the 10 of you in this class, think of the macrocosm. Ands there is an affirmative action policy for that too. I have provided you with ample example to practice what you need to know for the exams, you know what they say practice makes perfect, so come on perfect those testable SKAVs and better our school results. Your picture will appear in the news paper as an advert for the excellent quality of education offered by this independent school. Now tell how you extract DNA from peas, onions, wheat and the rationale for each procedure.

L: explains the steps taken to extract DNA

T: I want each of you to prepare a slide of DNA and observe it under the microscope, note the shape, number of rungs, make a labeled diagram of your observation and present your observations orally

.

It is obvious that GVN engages in a lot of forward planning to ensure that learners engage in hands on activities to study the structure of the DNA molecule During the presentation GVN serves as a facilitator of learning directing the learners attention to the model of DNA and RNA and then to their slides.

T: The following concepts are important in this section replication, translation, transcription. Each terms is discussed by the teacher, (he writes the terms on the board. For homework you have to write an essay on protein synthesis these terms will be used in that essay. Remember you are writing a 2,5 hour controlled test so practice your essay writing skills and get used t working in a limited amount of time.

Viewing GVN’s teaching portfolio file reveals that multiple opportunities are provided for learners to engage with LO1, LO2, and LO3 in their respective assessment standards during the informal assessment but most activities focus on

hypothesis testing and formulating hypothesis. Informal assessment tasks are designed to meet learners needs however learners are given tasks that extend beyond the SAG doc. In other words learners are given higher order questions. Informal tasks are self assessed by the learners, the educator provides a memo for each task that the learner files with his/her assessment (50) short informal tasks were given to date to learners, the tasks foreground LO1 and LO2. In all lessons reference is made to the exams and what is expected of learners in the exams.

MSS

The road leading to MSS school entrance is un-tarred for about 1 km. The rest of the road was tarred. The school is surrounded by a one meter wire fence. There are no guards at the school gate, the gate remains open for the entire day. There is no designated car park, teachers park their cars within the school yard. Most learners walk to school and a few travel by taxis. The learners are all clad in their full school uniform. A group
of boys were playing on a huge soccer ground and a few girls were playing with skipping ropes in the school yard. The school bell rang and the learners scurried to the assembly area. The assembly was being conducted in English. MSS is a school that is situated within a black community

After the assembly I was met by GR, the principal of MSS for the past 10 years. MSS has maintained a pass rate of over 95% in the matric exams for the past 10 years. In 2007 the overall pass rate in the national matric exam was 98%. GR is a committed to his school and the community and has arranged for ABET class to be conducted at his school to improve literacy in the community, these ABET classes started in 2002. GR pointed out the newly built computer room that MSS has acquired from DoE as it was considered to be a disadvantaged school. MSS had received more funding that the other neighbouring schools, as the road leading to the school were un-tarred. The DoE had built a computer room at MMS and also supplied computers but no teacher to teach computer studies or computer literacy. GR complained that the officials in the DoE lacked fore sight as one year has elapsed since the computers were installed in the computer room and to date he is still awaiting a computer teacher. The bell was rung again, GR informed me that the entire school has a reading period every morning to promote reading amongst the learners, this helps to improve the learners comprehension, vocabulary, writing skills which in the end will enhance learners performance in the exams. The enrolment of the school is 780 “black” learners, but the staff composition was reflective of our rainbow nation, they are black, Indian, white and coloured educators at his school. The bell was rung for the commencement of the first period.

Lesson 5: Mitosis and meiosis

Duration: one hour

Focus LO: LO2

The lesson occurs in a classroom MSS did not have a lab. There are 52 learners in the classroom and the class is crowded with, but neat, with little room for movement. There are a few charts on the walls of the class-HIV/AIDS, a timetable, calendar, binomials. Learners have desks, chairs, text books. There is a huge blackboard that dominates the front of the class. The teacher, DD, conducts most of the lesson in English but uses isiZulu to enhance understanding.

T: Today we are going to learner about mitosis and meiosis- teachers writes these two terms on the board. Now say after me. Mitosis one cells divides to produce two identical cells

L: repeat the definition of mitosis

T: Hey weanh, why are you not saying it

L: Ka, shrugs the shoulders

T: I teach in English and isizulu but you have to try to speak and understand English, the exam paper is in English how you gonnna know what to do, you will bring our school pass rate down and everyone will think I can't teach.

L:

T: Say after me meiosis one cell divides to produce 4 un identical , it is known as reduction division, the chromosome number is reduced to half, it occurs in sex cells

L: Repeat the definition of meiosis

T: Now take your textbook and observe, identify, draw and label diagrams from the textbook and list a visible distinguishing feature for each phase of mitosis and meiosis.

Learners were given 20 minutes from this task.

T: Now look at the diagrams for each phase and tells me the differences between mitosis and meiosis.

L: Answer the question posed by making references to their notebook.

A chalk and talk approach is used by DD. The blackboard becomes the focus of attention point s/ terms are written on it as the lesson progresses and learners copy these points/ terms into their notebook. When learners are asked question some respond in isiZulu while a few respond in English. Learners do not ask questions they only respond to questions asked by the teacher. A drill method is used by DD to ensure that learners can recite the meaning of certain terminology.

Observing DD's teaching portfolio file reveals that multiple opportunities are provided for learners to engage with LO1, LO2, LO3 and their respective assessment standards during the informal assessment. DD has the assessments typed in English and isiZulu. The exams type questions are strongly foreground in all the informal assessment e.g. hypothesis testing and planning of investigations. Written comments are provided by DD to the learners on their formal assessment tasks, specifically on their areas of weakness and what they could do to improve their result. DD also remains in school from 2:30 to 3:30 so that he could monitor/ assist his Life Sciences learners with their homework/ schoolwork.

Annexure D6: Questions for post observation focus group interview

1. Our findings reveal that you focus on the following SKAVs: **Skills**: problem solving,
data analysis, interpretation, hypothesis testing, investigations; manipulation of apparatus and data; reporting; team work
Knowledge: As per curriculum; Concepts; Understanding terms; Genetics; IKS; DNA
Attitudes: Positive attitude; Opened mindedness**;** Appreciate IKS**;** Tolerance**;** Respect; Responsibility; Sustainability
Values: Democracy; Ethics in research; Past research**;** Honesty**;** Sustainable living**;** IKS**;** Laws of the county**;** Citizen responsibility**;** Critical thinking in your engagement with the NCS-FET Life Sciences curriculum.
Could you perhaps provide some clarity on this practice?

Annexure D 7

Post observation focus group interview transcript
R= researcher T=teacher
R: Good afternoon colleagues I'd like to thank you for participating in this study and the focus group discussion that will pursue. Not so long ago you received a questionnaire from me that focused on SKAVs Life Sciences teachers focus upon in their teaching and I have observed your lessons. What I'm going to do today is share the data obtained from the analysis of the questionnaire and the observations. The data indicates that teachers focus on the following SKAVs in their teaching:
Skills: problem solving, data analysis, interpretation, hypothesis testing, investigations ; manipulation of apparatus and data; reporting; team work
Knowledge: As per curriculum; Concepts; Understanding terms; Genetics; IKS; DNA

Attitudes: Positive attitude; Opened mindedness; Appreciate IKS; Tolerance; Respect;
Responsibility; Sustainability
Values: Democracy; Ethics in research; Past research; Honesty; Sustainable living; IKS
Laws of the county; Citizen responsibility; Critical thinking
The above data indicate that teachers foreground SKAVs focussed upon during mediation of policy and other SKAVs not focused upon during mediation of policy. I'd like some clarity on why you focus on these SKAVs in your engagement with the NCS-FET Life Sciences curriculum.
T1: It simple we structure our lessons with the exams in mind, so that our learners can excel in the exams. Also during our training session with the subject advisor he emphasised hypothesis testing and planning investigations so much that it's a certainty in the paper.So we focus on that. We want our learners to excel in the exams, then we also look good, the principal will be happy, SEM is thrilled and feels he is responsible for the results. The end result everybody is happy and you are not bugged about your results at meeting. Come now you know about the graphs we receive at our first meeting. The graph that ranks "our" performance in our district via the learners results in the exams.
R: Why?
T2: You, **know we are like Guinea pigs with this new curriculum, we are trying to implement this new curriculum with the minimum amount of training or support. (line 10)**
We didn't have a say in drawing up this curriculum now we have to implement it successfully. So we focus on the exams and teach the learner what is needed to pass the exams. We are both guinea pigs in DoE's experiment. To create the impression that we are successfully implementing the curriculum we teach the learner what is needed to pass the exams so the learner obtains a sense of achievement and we produce good **(line 15)**
results, every body is happy**. We need to show that we are au fait with the content and requirement of the curriculum. One way of illustrating this is by teaching for the exams so learners can acquire good marks.**
Another thing it the workload, we now teach other learning areas so there's no time to focus on everything so to cope, maintain our reputation, pass rate and market our school we focus on the exams. It's a win- win situation for all of us and everybody is happy, DoE, subject advisors, SEM's principals, parents and learners, IQMS scores are high and we get marking **(line20).**

R: Would you like to add to that T5
T5: Yes, think of the poor learners they came from cut and stick and poster assessments in grade 9 **(L21)**
into hypothesis testing, critical thinking, unaided investigations. They are guinea pigs as well, we are trying out this curriculum on them, so why not assist them in passing. **It's a win- win situation for all of us and everybody is happy. So I do what I can with the poor training I receive, I teach for the exams**
T4: **Every time there is a new minister of education there is a new policy, where's the stability for us**. That is only a part of the reason, the main reason why our teaching is directed toward exam is the lack of time, we do not have sufficient time to cover content, cover **(line 25)**
the three LO's , teach learners all AS's, complete formal assessment and multiple informal assessments and have time for the provincial testing program. You know this curriculum occurs within the confines of a school, there are many dynamics within the school situation that impacts on our teaching time such as curtailment of teaching time for fund raising activities, sport, observing peers lessons for IQMS, completing admin **(line 30)**
work, stats returns for department or district office, dealing with discipline issues on a daily basis.
T1: We focus on the SKAVs required in the exams as we are constantly reminded of our need to maintain a high pass rate at a school and district level. **We are judged by exam results, everybody expects good results so why not teach for exams? These results will go on their CAO forms for university entrance and, my IQMS rating will be high.** If our pass rate drops we are reminded about it at school and district level. Then we will be part of the SEM's **(line 35)**
twinning process in this district. That is so embarrassing to be attached to another school and will have to follow their lesson plans, assessment this can undermine a teacher's confidence in their teaching ability.
T3: IQMS and the PPN policy documents have a major impact on what we teach and how we teach. **(line 40)**
R; How so?
T3: Everybody wants a good rating from the SDT, we are judged by our learner's achievements in the academic and sport arena. We need to show that we are aufait with the content and requirement of the curriculum. One way of illustrating this is by teaching for the exams so learners can acquire good marks. PPN has resulted in us teaching other learning areas, it's difficult to manage doing justice to all aspects of the **(line 45)**
curriculum's content if you are not familiar with the content of a new learning area. To bring about some balance I focus on SKAVs that are going to be tested in the exam in Life Sciences. This allows me to devote more attention to Math Literacy, my other learning area. **There are many dynamics within the school situation that impact on our teaching time such as curtailment of teaching time for fund raising activities, attending to social welfare issues like house parties, drugs and alcohol abuse, sport, observing peers' lessons for IQMS, completing admin work, stats returns for department or district office, dealing with disc**
T2: Also the number of learners taking Life Science has decreased, so we may have a single class of Life Sciences per grade with about 48-55 learners. It difficult to **(line 50)**
focus on the learners needs, it is easier to focus on the exam requirements and prepare learners for the exams.

R: How do you account for this decrease in number of learners taking Life Sciences?
T1: Other learning areas do not have lengthy content, difficult exam papers or two exam papers. Life Sciences is not a compulsory subject. Learners prefer to opt for subjects that are easier to pass, that are less demanding on their cognitive levels **(line 55).**
T3: Learners use the poor results in Life Sciences as a yard stick to decide against pursuing Life Sciences. **Other subjects have more A's than Life Sciences in the National Senior certificate exams, their papers are not long with difficult language**
R: Do you think this foregrounding of SKAVs needed in the exam could be related to the FET training that you received.

T2: yes, it is possible, during the training session the exams requirements are emphasized all the time. We've been trained for 3-4 days on the new curriculum. This training is far from adequate, the facilitators themselves are not sure of the policy document. **(line 60)**
How can they help us. We need sustained long term training with more exemplars and concrete example of hypothesis testing etc. we use both old and new teaching method due to training , uncertainties, our practice. **So I do what I can with the poor training I receive. I don't worry too much about the philosophy of the curriculum as it's not my vision for learners, I just focus on exam requirements**
T4: That's correct, the training we received is not adequate it is laboured during the training session that LO1 makes up 40% of the paper, LO2 40% and LO3 20%. Thus we concentrate more on LO1 and its investigative skill, accessing concepts and **(line 65)**
application of concepts/knowledge in LO2 and debates in LO3.
T3: You know this curriculum is being revamped and a new curriculum will be implemented in 2009. **w**. Don't you think we are tired of this, that we need some sort of stability for a **(line 70)**
while before we can change to a new curriculum? We have had 3new curricular in just over 10 years. Does the DoE ever stop to think how this impacts on teachers and teaching?
R: Don't you think that by focusing on exam expectation you are not embracing the philosophy of the curriculum?
T5: They, DoE has no time to worry about us, therefore they don't seek our opinions for curriculum development. They get the university personnel to do this. They decide what best and we are expected to practice and implement the curriculum in the classroom **(line 75)**
So I **do what I can with the poor training I receive. I don't worry too much about the philosophy of the curriculum as its not my vision for learners**. If you ask me we are really not ready of this curriculum as yet with the type of training we receive. All DoE has to do is look at the Math and Physics results to know that learners are battling, teachers are struggling to teach the content, many teachers themselves cannot answer the **(line 80)**
questions in the exams. What are we trying to do frustrate our children, make them feel inadequate. I think those people on the curriculum development panel have lost the plot to broaden access. Fewer black learners are taking these subjects so we will continue to have a lack of black scientist in our country. These personnel from the universities must look at the GET curriculum before they design the FET curriculum so there is continuity **(line 85)**
in terms of levels of testing.
T4: Policy planning is divorced from policy implementation and this causes a lot of problems for those of us who have to implement the policy in class. We do the best we can under trying circumstances. I promise you if those individuals from DoE have to implement the curriculum in our schools under our working conditions they will **(line 90)**
leave after a day.
R: Thank you for your presence. I really appreciate you making time to be a part of this post observation focus group discussion.

Annexure D 8

Analysis of implementation of policy : interview and observation						
How teachers feel about the NCS-FET LS policy/ what they say	**Which actors do teachers see as impacting on their practice?**	**How do they interpret the effects of these actors?**	**What is their response? what they do**		**Comment/ policy construction**	
We are like Guinea pigs with this new curriculum -We are both (teachers and learners) guinea pigs in	DoE bureaucracy NCS-FET curriculum Teachers Learners	curriculum is seen as experimental/uncertain/trail and error process curriculum reduces teachers and learners to a lower status power relation s during policy formulation	Foreground exams in implementation- How teach what is needed to pass exams I provide you with ample	What SKAVs required for exams: state hypothesis, identification	**As experimental** • alliance formation with learners to achieve positive	convergence

DoE's experiment -They (the learners) are guinea pigs as well, we are trying out this curriculum on them, so why not assist them in passing.			examples to practice what you need to know to pass the exams Hands on approach to teaching-make a slide Demonstrate I will demonstrate how to make a slide of leaf epidermis before you undertake the investigation -You works in groups, this is a hands on work pract activity -complete the pract worksheet, -you could use your textbook to answer questions -You have brought the culture of breadmould -use the handlens to observe the specimen - make a slide to observe, the specimen under high power - look at the chart of Futi and Dolly the cloned cow and sheep-pay attention to the video of "Look who's talking" Copy the terms from the board Look at these models and identify…. -Now tell me how you extracted the DNA from peas, wheat at home -prepare a slide and observe under different magnification	of variables, drawing of graphs,/tables, terminology, essay writing -Get parents to comment of test performance	outcome-affirms role of learners in their performance • obligatory alliance to DoE becomes conspicuous • affirmation of exam requirements-teaching turned into dress rehearsal for exams-exams becomes a control mechanism for teaching, learning, university entrance • subversion of policy goals iro vision for teachers and learners–controls SKAVs development teach for exams-power of exams during implementation emerges-teaching reduced • alliance formation with teaching tools to promote learner centred teaching to exam performance • forms alliance with parents	

			s		/schools/learners gets parents to be accountable for their child's results • forms alliances with tertiary institutions and learners for learners to achieve good results	
-we are trying to implement this new curriculum with the minimum amount of training or support -We need to show that we are aufait with the content and requirement of the curriculum. One way of illustrating this is by teaching for the exams so learners can acquire good marks.	Curriculum - content requirements of the curriculum Training support teaching approach Assessment - Marks/Exams	-Subverting the curriculum into something unfamiliar – as the "other" -Feeling disempowered / uncertain -Need to create a positive impression of curricula content- one of familiarity -Form an alliance with learners to achieve positive outcomes for learners	Foreground exams requirements " to create the impression that we are successfully implementing curriculum we teach learners what is needed to pass the exams"		**As a game** - implementation is construed as taking a risk/ something of value being at stake(SKAVs development agenda) it is dismissed as game playing an unimportant –assumption of good results being produced Alliance formation: Learners to achieve positive outcome Contradictory alliance formed with DoE- focus on external verifiable criteria that are divorced from curriculum outcomes	convergence
			how teaching approach: So I do what I can with the poor training I receive. I don't worry too much about the philosophy of the curriculum as its not my vision for learners	What It's a win-win situation for all of us and everybody is happy		
-We didn't have a say in drawing up this curriculum now we have to implement it successfully- Policy planning is divorced from policy implementation and this causes a lot of problems for	Teachers curriculum policy planning class	feel disempowered unavoidable situation Exclusion Separated segregated Alienated estranged	See policy is estranged and resort to ways to implement successfully- foreground exams		**Policy is estranged** Contradictory Alliance formation with DoE- i.r.o. policy implementation it is compulsory – no choice in the matter- power relations in DoE bureaucracy	divergence

those of us who have to implement the policy in class.					
-Other learning areas do not have lengthy content, difficult exam papers or two exam papers	Content of subject Assessment	as hindrance to implementation Difficult	Implementation foregrounds exams	**As a hindrance to implementation** Alliance formation Subversion of policy goals	divergence
-this curriculum is being revamped and a new curriculum will be implemented in 2009. -I'm just so sick of all this inadequate training, re training, deskilling, reskilling, trying to implement this curriculum only to have it changed before I get the hang of it. -Don't you think we are tired of this, that we need some sort of stability for a while before we can change to a new curriculum? - We have had 3 new curricular in just over 10 years. - Does the DoE ever stop to think how this impacts on teachers and teaching?	curriculum teachers training DoE	Something in limbo/ flux/ turmoil/ Feel destabilized Unhappy with poor training received, frequent change in curriculum and its impact on teaching and teachers	So I do what I can with the poor training I receive. I don't worry too much about the philosophy of the curriculum as its not my vision for learners Implementation foregrounds exams	**As mutating** Non alignment of practice with philosophy of policy Non alignment of teachers with training Subversion of policy goals in terms of teaching and learning approach	
You know this curriculum occurs within the confines of a school, there are many dynamics within the school situation that impacts on our teaching time such as curtailment of	School curriculum teachers More sub-actors are brought in(IQMS, admin work, DoE, district office	Curriculum implementation does not occur in isolation Need for curriculum formulation to be conscious of the what of the school dynamics Need to be contextualize curriculum with school dynamics Barriers to implementation Competing entities	Need to contextualization of curriculum How Awareness of school context 'I teach in English and isiZulu… you have to try to speak and understand English the	What Consciousness of factors impacting on teaching time e.g. fund raising, sport, IQMS, admin work, stats returns "IQMS and	**As an alien invader** Alliances formed with school context /learners Policy competes with other actors in school environment Subversion of policy iro language policy	

teaching time for fund raising activities, sport, observing peers lessons for IQMS, completing admin work, stats returns for department or district office, dealing with discipline issues on a daily basis			exam paper is in English"	PPN policy have a major impact on what we teach and how we teach … teaching other learning areas.. it's difficult to do justice … I focus on SKAVs that are going to be tested in the LS exams"	of implementation	

Table : showing synthesis of schools

Theme	PVS	FDC	MSS	MEIS
Location	Lower rung of property market, within suburb	Close to industrial area, along taxi routes, easily accessible	Rural, roads un tarred to school	Boarder of golf estate
security	2,5 m concrete palisade fence, guard at gate, gate closed, cctv	3m wall create fence with razor wire on top, guard at gate, required to fill visitors book at gate, gates closed	1.m wire fence , no guard at gate , gate remains open the whole day	Remote controlled gate , guard at gate, gate closed, camera at gate,
cleanliness	No litter, gardens well maintained	Garden immaculate, neat, clean, litter outside school gate	Neat, litter free, vegetable garden	Clean , neat, garden well maintained
Infrastructure physical	Buildings are old, no graffiti, window panes intact, admin block, library, physics and biology labs, metal work room, 20 classrooms.	Admin block refurbished, feeding scheme for Gr 1-7 only	No car park, computer room, labs,	Building old , excellently maintained, tennis court, swimming pool, labs
Schools fees	R600.pa, but a 40% return rate	R550 p.a, 33%retuen rate.	R250 p.a. 50% return rate	Ranges from R12 000 to R22 0000 p.a.
Teaching ethos	Teachers arrive early, holiday classes, extra tuitions, extra curricular activities principal and D.P strict, discipline policy enforced, late comer reprimanded, fund raising venture to maintain school,	Principal passionate about reaching, teacher enthusiastic , extensive fund raising to maintain school, principal strict,	Teachers arrive early, principal energetic about promotion of education in community, strict discipline	Teachers concentrate on teaching, no fund raising by teachers, extra curricular activities conducted by coach
Learning culture	Career talk organized by principal, 100% pass rate in matric exams, learners in school uniform or school track suit.	98% pass rate in matric exams, learners in school uniform	98%pass rate, learners in school uniforms	100% pass rate, learners in school uniforms
DoE policy impact	Have to market	Have to fund raise	No computer studies	DoE policies do not

	school, many high schools in area all compete for the same grade 7 learners, use excellent matric results, codes of sport offered, extra lessons offered, grant bursaries and discounted fees to attract learners	extensively, funding determined by infra structure of school e.g. brick building, tarred roads, water and electricity supply, Up set that they have to fund raise yet DoE returns millions of rands designated for upgrading rural schools. Up grading all rural school allows for all schools to get the same amount of funding. Have a feeding scheme funded by DoE only for grade 1-7 , school has from grade 1 -12 difficult to tell a hungry child who was a part of that feeding scheme that now that you are in grade 8 cannot eat	teacher to offer computer studies at school yet DoE has built a computer studies room and fitted it with computers	affect their teacher pupils ratio or teaching loads

Annexure D9: Questions for conservation with SEM

1. How do you account for the success of your region in terms of academic and extra curricula activities?
2. I have learnt that there are many teachers' resignations in our region. How do you account for these resignations?

Annexure: D 10

Transcript of interview with SEM

Interview with SEM
R= researcher SEM= Senior education manager
R: Thank you for agreeing to meet me at such short notice and for accommodating me into your hectic schedule
SEM: It is only a pleasure to have you back in my office, How is your study progressing?
R: I am on target with the time line that I set for my self, so I'm making good progress
SEM: Well, your colleagues miss you in this region, quiet a few of them have resigned.
R: I've heard about those resignations when I was out delivering the questionnaires for my study. Can you tell me more about these resignations in our region?
SEM: Sure, there have been 60 resignations in this region over a period of about almost a year. That means that I have lost almost 5 teachers per month. You know this really saddens me. Many of them are my seasoned teachers and something really had **(Line5)**
to push them to make that decision. You know it upset me when these teachers came to say good buy to me as I could not convince them to retract their resignations. I don't blame them for resigning, teaching is not the same profession they entered 15 to 20 years ago.
R: How so?
SEM: There are more pressures on teachers now with the many curricula changes that we have had, they are trained for what 4,5 to 5 days and are expected to implement **(Line10)**
the curriculum in class perfectly, assessments requirements change all the time, new lessons have to be prepared, then

there's making which eats into personal time with the family, setting of tests. Exams, teaching learning areas that they have no formal training in due to the PPN of the schools, extra curricular activities I know that the schools in this region use the activities offered at schools to attract learner to their schools, you **(Line15)**
know it becomes a numbers games, so my teachers are under tremendous pressure to perform all the time in the classroom , out of the classroom. I don't have to tell you about our academic performance as you have been a part of my twinning programme to ensure that the schools in our region all obtain pass rates over 78%. Then IQMS adds to the pressure of teachers performance in the class, out of the class is used to **(Line20)**
determine the performance "bonus" in their salary. Another reasons why these teachers have resigned was the salary- for the qualifications teachers have they earn far to little, I know that teaching is a calling but it is also a survival issue – they need to be able to support their families and not live from one pay day to the next. Also teacher have to cope with severe discipline problems in schools, they were not trained to deal with **(Line25)**
the kinds and types of discipline issues they confront on a daily basis, drugs, sex, house parties, child abuse etc.
R: So you are saying that teachers have resigned due to the intensifications of their workload and their inability to cope with it?
SEM: Yes that first part is right but I think it goes beyond coping, all this change leads to frustration, a sense of insecurity as there are all these factors that make inroads into the teaching time, it could get overwhelming if you do not receive support from**(Line30)**
the management. This is something that I cannot discuss with you as you know that SGB have appointed the management of almost all schools in this region.
R: What have you done in instances where management do not support their teachers?
SEM: I can only intervene when a formal complaint is received, I cannot act of hear say. The formal complaint must be accompanied by proof.
R: In spite of all these social factors how do you account for the success of your region in term of academics and extra curricular activities?
SEM: You know that my schools are previously disadvantaged schools, they **(Line35)**
all do not receive the same funding, some receive more funding than others. I have a hands on approach with all my schools, I visit them on a regular basis, address the staff as well and when they are not "performing" in certain areas I arrange with the management to become a part of my twinning programme. You have assisted me with this where we have used all your lessons , assessment tasks in the school that was not achieving and**(Line40)**
you conducted workshops on practical work, weighting of papers to help those teachers to be able to do these thing by themselves. Well I still continue with that but I have extended the twinning programme to financial management, resource management and the SGB. So I just keep on trying to get all my schools on par.
Phone rings. This is an emergence that needs urgent attention.
SEM: I have to attend to an emergency, I hope I have assisted you**(Line44)**
R: Thank you, you have shed a lot on light on teacher resignation and intensification of teacher workload and these extra duties teachers are expected to cope with.

Appendix E

Annexure E1: Questions for semi structured interview with education officer and mentors

Your industry has in its employment a large percentage of "non tertiary educated workers" i.e. worker's who have only received an education at school.

1. What SKAVs are needed by your industry in non tertiary educated workers?

2. Is there a specific knowledge base that the NTEW need to have to be employed at this industry? Please elaborate

3. What are the basic SKAVs the NTEW need to have to be employed at this company?

4. Is there an internal training program for the NTEW?

5. What is the frequency of this training program?

6. For worker who experience difficulty in acquiring the new SKAVs during retraining what type of contingency measures are set in place?

7. Are these workers who "fail" during the retraining session a financial burden to your company in term of money spent on skills development?

8. What eventually happens to these worker who" fail" during the retraining sessions

9. How would you describe the "learning environment" in your industry? And what type of support structures are provided by your industry to your workers?

10. What expectations, in respect of SKAVs, does this industry have for prospective non tertiary educated workers emerging from the schools?
11. Do any of subjects assist in acquiring skills needed in the NTEW? Please elaborate
12. Is there any correlation/link between your current training and SKAVs acquired in Biology?

Annexure E2 comparative analysis of interview conducted with education officer and mentors

mentors	EO
1.SKILLS	**SKILLS**
reading information	reading information
manipulation of apparatus	manipulation of apparatus
identification of compounds	identification of compounds
team work	team work
follow instructions	follow instructions
follow scientific procedure	follow scientific procedure
communication-oral, written, labeling	munication-oral, written, labeling
listening skills	listening skills
perform basic calculations	perform basic calculations
computer literacy	computer literacy
people interactive skills	people interactive skills
questioning skill	questioning skill
	mental alertness
	maturity
	ability to cope with stress

	ability to work under pressure
	personal grooming
knowledge	**knowledge**
human digestive system	human digestive system
excretory system	excretory system
nervous system	nervous system
endocrine system	endocrine system
diseases-causes, symptoms	diseases-causes, symptoms, prevention, treatment
use of computer, telephone, email	use of computer, telephone, email, internet search
attitudes	**attitudes**
to be empathetic	to be empathetic
to be honest/responsible/accountable /law abiding/ ethical	to be honest/responsible/accountable /law abiding/ ethical
	pride- personal grooming
values	**values**
leadership	leadership
integrity	integrity
honesty	honesty
dependability	dependability
team work	team work
	good judgment
	good health
	good grooming
	personal attribute
2. specific knowledge based needed in industry	**2. specific knowledge based needed in industry**
human physiology/anatomy	human physiology/anatomy
diseases-causes, symptoms, preventions, treatment	diseases-causes, symptoms, preventions, treatment
elements and compounds-name, formula, read mass	elements and compounds-name, formula, read mass
ability to do conversion of metric units	ability to do conversion of metric units
ability to perform basic calculations	ability to perform basic calculations
knowledge of using a computer, telephone, fax	knowledge of using a computer, telephone, fax
3. SKAV's present in NTEW after matric	**3. SKAV's present in NTEW after matric**
reading scripts- practical procedure, basic calc., measuring, massing	reading scripts- practical procedure- investigation, manipulate apparatus ,follow instructions,, basic calc., measuring, massing
4. Retraining	**4. Retraining**
yes- internal mentoring	yes- internal mentoring
internal evaluation	internal evaluation
external evaluation	external evaluation
5.Frequency of training	**5.Frequency of training**
regular basis- almost daily	regular basis- almost daily
6. contingency measures for "failed learner"	**6. contingency measures for "failed learner"**
more mentoring	more mentoring

internal evaluation again	internal evaluation again
HRP intervention	HRP intervention
7.no financial burden to company	**7.no financial burden to company**
8. HRP intervenes- opportunity to retrain at a convenient time	8. HRP intervenes- opportunity to retrain at a convenient time
9. A relaxed mentoring process	9. A
internal evaluation more rigorous- can be stressful	internal evaluation more rigorous- can be stressful
10. expectations of SKAV's in new NTEW	10. expectations of SKAV's in new NTEW
communication skills- reading, writing, listening, computer literacy,	communication skills- reading, writing, listening, computer literacy,
telephone etiquettes	telephone etiquettes
basic calculations	basic calculations
measuring techniques	measuring techniques
massing techniques	massing techniques
identification of compounds	identification of compounds
team work	team work
manipulation of apparatus	manipulation of apparatus
follow instructions	follow instructions
plan and carry out procedures	plan and carry out procedures
work methodically	work methodically
to be responsible/sensitive/tolerant	to be responsible/sensitive/tolerant
11. Life Sciences, math, English	11. English- for communication, math –for basic calculations, Life Sciences for basic SKAVs and knowledge content
12. Yes, it forms the basis of the WPL	12. The wpl draws on the foundation created by schools and builds the SKAVs needed in this industry.

Annexure E3: Observation schedule for SKAVs enrolled during mediation of work place learning

Learning outcome	**SKAVs**	characteristic	competent	practice required	needs help
LO1 (14)	communication- written, verbal	can they read, write a script			
	processing	can they process an order, arrange a batch for dispatch			
	questioning skills	do they challenge what is said to them, do they have an enquiring mind, do they ask questions about the production process, ingredients used.			
	plans and carries out procedures	can they think ahead, make projection, estimates and conduct procedures			
	recognizes technical problems in apparatus	able to see, know when there are problem with apparatus,			
	measuring -reading scales, counting	can they measure accurately, use different scales, perform conversions from one scale to the next			

	pipetting techniques	can they draw liquid into a pipette without drawing the liquid into their mouth			
	correct use of mass meters	do they know how to use a mass mater, select the proper mass units			
	calculations, ratio, mass, dosage	can they perform simple calculation, ratios, dosages needed to manufacture products of company			
	collecting and selecting materials	can they identify chemicals needs and select them in the correct rations needed			
	follow instructions	can they listen to instruction and recall and execute them			
	accurate reading of meniscus	do they know how from which curve to take readings of liquids			
	problem solving	can they find a solution to any technical or procedural problem identified in the production room			
	share findings	are they able to explain the results of their investigations orally, visually			
LO2 (7)	knowledge and proficiency	ability to recall, access knowledge learnt/theory			
	dead stock, expired stock, disposal procedure	are they familiar with the process of stock inspection and circulation, do they know how to dispose of medication, stock that has expired safely			
	Safe handling of materials-	properties of materials used to work with them safely, , avoid accidents, do they know how to counteract certain hazardous chemical reactions , work cautiously with chemicals			
	compare sources of information	can they see similarities /differences in methods/techniques used in the manufacturing process			
	computer skills	use and access information from computer, send emails			
	storage and movement of stock	do they know how and under which conditions chemicals, stock needs to be stored			
	stock register and ordering	can they maintain the stock resister that show the quantity of each chemical used, needed and make an order for those that are almost used up., note expirers dates of stock and rotate for use			
LO3(14)	honesty	do they admit their mistake if any when working in the production room to prevent liabilities against this company.			
	social responsibility to team	can they work as part of a team, put differences aside, share ideas, find solutions			
	tidying and cleaning of stock area	neatness displayed in production room i.r.o. work stations, storage of chemicals, disposal of wastes			
	people interactive skills	can they get along with other workers, pleasantness to clients, sensitive to clients needs, manners displayed, patients , tolerance to irate clients			
	mental alertness	ability to concentrate, be aware of surrounding and actions			
	work standard	how dedicated committed they are to work and company, display sense of pride in job			

	make rational judgments	decisions made can be trusted, does not jeopardize colleagues or company			
	ability to cope with stress	not absent for exams, can think on their feet, does not display unacceptable behaviour, does not redirect anger, irritation at another worker			
	maturity	not childish, serious about work, no horse play in production room			
	leadership	can take control of learning, group, work independently			
	ethical skills	not childish, serious about work, no horse play in production room			
	dependability	can we trust them, rely on them, their decisions, actions, loyalty			
	telephone skills	can they make/receive calls with politeness, confidence, professionalism			
	listening skills	can they be attentive to the WPL programme, client			

Annexure E4: Guideline questions for Snapshot "conservations" with NTEW

13. What is your age?
14. When did you start working at this company?
15. How long have you been employed by this company?
16. Recall any incident that occurred during your schooling that you cherish or want to forget/avoid
17. Did any of subjects you had studies in high school assist you in acquiring skills needed for your current job as trainee assistants to the Chemist?
18. Is there any correlation/link between your current training and SKAVs acquired in Biology?
19. Comment of the mentoring you have been receiving thus far?

AnnexureE5
WD Snapshot in detail
Snapshot

Who they are

I am 21 years old and I started working for this company 18 months ago. I am being trained as an assistant to the pharmacists in our production room. I work very well with my personal tutor (BC). He (BC) is an easy going person, who is understanding and supportive and takes his work seriously. He instils in me confidence and makes time to answer all my questions about things I do not fully understand. **(line5)**
He allows me the space to try and practice my skills. He reminds me of my Mam. I have made good progress in completing and passing the formal aspects of my training. I don't like the way in which the EO treats me during the evaluation process. She reminds me of those teachers who were racist to me while I was in school. I sometimes feel that she does not want me to work here, she is very influential**(line10)**
you know she has shares in this company. She will do anything within her power to get me out of this production room and moved to another department. I know that I am good at my job but I need to be treated with respect and dignity. Just because I am Black it does not give her the right to treat me differently from the other 18.2's. She needs to stop seeing my colour and start seeking my excellent performance. **(line15)**
My marks and performance rankings are better than that of the other 18.2's but she does not acknowledge this. All I want is for her to acknowledge that I am good. During our evaluations she speaks to me in an arrogant tone, singles me out to perform skills and does not comment when the skills are preformed perfectly. She often remarks that I think I am too smart and I am to savvy. With her around**(line20)**

I don't know what is in store for me at this company. She wields a lot of influence over the management. I asked don't you think that she is trying to ensure that you complete your training successfully. WD explains that I have learnt to block her out of my mind and not react to her during the training. This is my coping strategy. If I let her get to me , I will not be successful with my training. WD responded then **(line25)**
she should have the same expectations of all the 18.2's and treat all of us the same. I asked do you enjoy a good rapport with the other 18.2's? WD responded yes, but ABS seems to have a problem accepting that I am progressing faster than him. I asked how do you know this? WD responded he told me so, WD continued I get along with all the 18.2's and I understand where ABS is coming from, he has a wife and **(line30)**
child to support so for him the need to succeed is greater and he is older that all of us. I asked so you are not angry at ABS's comments towards you? WD responded no, I feel sorry for him and I promised to help him with the task he has to redo. I asked WD do you think that any of the subjects that you did at school prepared you for the world of work. WD responded not all of them, some of them did e.g. Biology. **(line35)**
English and math, Biology is very useful in terms of the practical work we did it has helped me to manipulate apparatus, plan activities , write a report, measure accurately and the content on human physiology, diseases, biological compounds assists me with the formal aspects of our training. I asked is there a link between the Biology curriculum and the SKAVs that you are acquiring now. WD answered that **(line40)**
there was a link but the SKAVs required now were more in-depth. WD continued my Bio mam allowed us to conducts practical by ourselves. I commented your school must have been well resourced. WD replied our mam insisted on using whatever was in the lab and often she would go to neighbouring schools to borrow equipment for practical work. I asked what about English and Math. WD replied English**(line45)**
is the medium of communication and math helps with the basic calculations. I asked have the skills, knowledge, attitudes and values that you have acquired via the biology curriculum been developed, built upon, and changed at work. WD responded yes they have been built upon and they have changed **(line49)**
.

What they were
I lived in Kwa Mashu with my Gogo's (grandmother). She was responsible **(line50)**
for my very existence, she sent me to school and took care of me. We had survived on her social grant. My mum had left me in the care of my gogo and had moved to Johannesburg to start a new life. My only contact with my mother was via phone. I have tried to listen to Gogo and had always tried to be a good boy while in school but I somehow got into trouble with my friends on a weekly basis. Trouble **(line55)**
seemed to have a way of following me. My gogo had insisted that I attend an Indian school from grade one so that I could learn to speak better English. I remarked that ex-DET school also taught English. WD responded they do, but the teachers and learners are different. I questioned how they were different. WD responded that in many township school the motto of" pass one pass all exists" **(line60)**
(i.e. learners demand that all learners should pass, teachers are often threatened if the learners do not pass, and thus all learners are passed). WD looked at my face and said you don't believe me. I responded I hear what you are saying but at the same time this is not a practice in all ex-DET schools. WD responded this is a practice of the schools close to where I lived. He continued I could not afford to study, money and**(line65)**
food was scarce, many youth in the township are unemployed and are W 'n T so what was the point in me working hard? "what's the point in working hard when we cannot get jobs, our parents are poor and cannot afford to send us to study, our families live in debt, we are doomed to live in council houses, schooling days were punctuated with many suspensions. I saw no hope for myself, t While in**(line70)**
primary school I had started to smoke, drink and use drugs. I asked where did you get money for this. WD replied the older boys used to supply me with these things as I used to be their "eyes and ears" (spy) in the township. I asked does this mean you worked for them. WD replied yes, it was the only way to save myself from getting a beating from them. I enquired could the community elders not speak to these boys on your behalf. WD replied I didn't want to be seen as a "moffie" **(line75)**
(guy person) who can't sort thing out for himself. WD continued these older boys they rule the township, I didn't want them to interfere with me or gogo. WD stated that smoking and drugs were a form of escapism, for him, it also made him loose his appetite, he said you know food was always short at home. When I went to high school my bad reputation followed me even though I tried to redeem myself. **(line80)**
Teachers always treated me badly and suspected me of petty theft. I enquired how the teachers in high school knew about his behaviour. WD replied, the teacher had heard the stories about his behaviour in primary school from the children who were in his class in primary school. WD stated that he had always felt that he was being targeted by these Indian teachers. I asked did you not take the matter to the RCL **(line85)**
(representative council of learners) and ask the RCL to intervene on your behalf. WD responded they would not take a thug seriously. I commented you saw yourself as a thug. WD replied yes, I actually didn't want to be a thug but I didn't know how to stop being a thug, how to change my behaviour. WD continued this problem continued up to Grade 11. In grade 11 I had a new teacher. She had always **(line90)**
treated me with respect and dignity and complimented me on my work and the effort I made in all my tasks. I felt I needed to change, I actually wanted to change, I didn't like myself or what I did to others. WD explained I felt I could

not let my Mam down as she was the only person who had a positive expectation of me, I felt like she trusted me, she knew I could change, that she saw good in me. He recalls **(line95)**
what made him feel special is she called him son when she spoke to him. No one had ever called me their son before this, not even my mother WD said. I tried very hard to refrain from my bad habits of smoking, gambling and drinking. I knew that Mam disapproved of these bad habits. I was often mocked by the other boys from the township for trying to live up to the expectations of "MAM". Mam kept **(line100)**
encouraging me to be good, she made me look at pictures of the organs of smokers and drug addicts. I finally quit these filthy habits and stated concentrating on my studies. I now wanted to pass for my self, so I could get a good job someday. A few of the other teachers started treating me with respect. I enjoyed and liked the new responses and respect that I got from some of my teachers. This caused **(line105)**
problems for me with the boys from the township. I asked why did it cause problems for you .WD replied because I wouldn't do what they expected me to do and I didn't want to be a part of the gang in the township. I asked were you a gang member? WD responded he was not a gang member but just an informer. They suspected me of being a spy for the office when I stopped being their "eyes". When they **(line110)**
had got caught drunk in school at the beginning of our matric year, they taught that I had "ratted" on them. The next morning, I was assaulted and stabbed outside the school back gates by these boys. The security guard had witnessed me being attacked but had refused to help me or stop the boys from beating me. I responded but he is the security guard he is supposed to prevent fights and maintain order. WD **(line115)**
replied this security guard was "on the take", we used to bribe him with money, cigarettes and organize girls for him, so I guess that he had received something big from the boys therefore he could not help me. I asked were you conscious did nobody else try to help you. WD replied he was conscious. The sweet aunty (a vendor that sold sweets outside the school gate) ran to the office for help. The principal **(line120)**
and a few teachers came to the bottom gates. The Bio Mam came with the first aid kit and tried to stop the bleeding. I tried to explain to my mam that I didn't interfere with the boys, but she asked me to be quite. The principle remarked that the teachers should not worry too much as I was definitely up to my old tricks, he said "a leopard does not change its spots". The Bio Mam informed the principle that I**(line125)**

needed immediate medical attention. The principle informed the teachers who were there that the school could do nothing to assist me as this incident happened outside the school gates. This was now a police matter. My Mam and Bio Mam told the principle that they could not leave me alone alongside the road without medical attention. They told the principal they were going to take me to the clinic. **(line130)**
I had received stitches on my skull, chest and leg. Mam had called Gogo and informed her that I was unwell and asked her to come to Phoenix so that we could stay with my aunt in Phoenix as it would be easier for me to travel to school and get medical attention should I get unwell again. Gogo did not ask questions as she knew Mam very well and was grateful to her for helping me. Mam called the **(line135)**
Phoenix police station and reported this incident to them. She asked the police commissioner to get the school guard to identify the boys who attached me and to open a charge of assault against these boys. The boys were arrested and released into the custody of their parents. After this incident I become more determined to succeed and escape from the township way of life. We now lived with my aunt. I **(line140)**
could not see myself W 'n T like the other boys. I had dreams that I wanted to achieve. I want to be somebody some day. Whenever I feel down I keep hearing the voice of Mam, "Remember son, every one is an achiever, but only if they themselves want to achieve".
My grade 12 year was very traumatic for me. Gogo had contracted T.B. and **(line145)**
she died in June. With the continued emotional guidance and support I received from Mam, English mam and Afrikaans mam I remained motivated and committed to my school work and passed matric. In October Mam informed me that I should apply for a job within a pharmaceutical company that was looking for matric student who had taken Biology as a subject. Mam made the necessary arrangements for me in**(line150)**
terms of my CV, character reference and testimonial. My interview for the job of pharmacist assistant was successful. I called the Mam to thank her for believing in me and promised her that I will not let her down and that I will continue to refrain from my bad habits.

What they should be
I am not happy working for this company –especially the EO. I enjoy my **(line155)**
job.I am grateful for having had this opportunity to study on site but I do not like they way in which I am treated by the EO. She is the only person that is difficult to get on with. My mentor BC is a good person, he is kind and humane. We cannot complain about the EO to the HR personnel as the EO determines who should work in the production room. Our fate lies in the EO 's hand. I am not prepared to act as **(line160)**
if I like her or "suck up" to her. She must accept me for who I am and the dedication, loyalty and commitment I display towards my job. I am also not happy with my salary, why should I get paid less than the pharmacy graduates for doing the same job. I have tried to raise this issue with the EO and HRP. The EO told me you are not a graduate to command a high salary. Once I graduate as pharmacist assistance**(line165)**

I will be trying to get a better job elsewhere, where I can be treated with respect and dignity. I have been saving money every month for my studies. I actually know how to manage my budget and I never spend more that I earn. I am hoping to further my studies and someday apply to study pharmacy at university. So I too will be a graduate who can earn a large salary in the future**(line170)**

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I saw ABS in the store room examining expiry dates and recording them on a "stock sheet". I asked if I could observe him and he responded sure. He asked me "why are you really here". I told him that I was here to look at the skills used in executing their jobs and to see if school developed these skills in learners in order to prepare them for the world of work. He asked do you think school really prepares people for the world of work. I responded that what I'm trying to find out.

ABS LINK-Who they are

ABS is 35 years old. He had been with the company for 4 years but had only just begun his training. Unlike the other 18.2's ABS does not have a matric certificate. ABS said his current employers had decided to train him as a pharmacist assistant due to his enthusiasm, loyalty and commitment to the company. He has two years to complete his training which consists **(Line5)** of formal and practical testing in order to obtain a certificate as a pharmacist assistant. He is married and supports his wife, child and mother. ABS stated he is unhappy with the availability of his tutor to assist him with the formal aspects of his work. His tutor is the EO. He reveals that no time is set aside for him during the working day to get assistance with the formal aspects of his **(Line10)** work. ABS describes his relationship with his tutor in terms of mentoring and support received as "not good enough for me". ABS also states that his performance during the evaluation sessions impacts on his working relationship with his tutor and will impact on his movement within the company. He expresses frustration he feels when he is unable to express his **(Line15)** concerns about his lack of access to his tutor. He feels that lack of access to his tutor will prevent him from completing his training within the specified time (2 years). ABS states that he does not get the same attention as the other 18.2's. He feels that the EO devotes too much attention to WD during the evaluation process because he is black, because of affirmative action and equity. **(Line20)** ABS states that he does not think that WD was accepted into the company purely on merit. ABS continues he sees WD as a threat to his chances of having a good rapport with the EO. **(Line23)**

What they were

He stated he has a grade 10 education. He had to leave school in grade 11 before the end of year exams as his father had passed on. His mother **(Line25)** was a housewife and she had never worked before. ABS stated that as the eldest child in the family he was expected to take over the role of provider for the family. This is our tradition he said and I could not let my mother and my 3 siblings down. I come from a family that is seeped in the traditional Indian way of life. ABS explained that his mother has no say (voice), during **(Line30)**
decision making, all decisions are made and taken by his fathers brothers and himself. ABS continued that he had worked in a construction company for 7 years with his uncle prior to working here. He commented he had worked very hard during those 7 years and that he had suffered from aches and pains from all that hard work. He stated, he was a handy boy (a jack of all trades) and**(Line35)**
a driver. When he had worked at the construction company he had, had an accident while driving and was fired on account of the accident. ABS continued saying he had also worked in a photographic company for 3 years after his job in the construction company. I asked ABS do you think that any of the subjects that you did at school prepared you for the world of work. ABS stated**(Line40)**
that he had left school a long time ago and was uncertain if schools subjects helped him with his jobs.

Where they want to be

ABS sees no opportunities of upward mobility within this company. He hopes to find a better paying job in the future once he gets his certificate as a pharmacist assistant. This will allow him to take better care off his family and**(Line45)**
provide for his child to get a tertiary qualification. His rapport with the EO is poor

SA LINK

I saw SA entered the disposal room, and decided to follow her.

Who they are

SA is 19 years old. She is working for the company for the second year and is in the second year of training as a pharmacist assistant. SA has a vivacious personality and tends to be talkative. SA states that she enjoys working at this company, but openly admits that she has been cautioned by the HRP about her "friendships" with fellow worker. SA continues that she thinks that**(Line5)**
the HRP does not understand what it means to be young and free from the watchful eye of an overprotective aunts and

grandparents. SA comments she is pleased with her progress as a trainee pharmacist assistant. She is determined to complete her training by April and obtain a certification as a pharmacist assistant as this will mean a big increase in her salary. SA continued **(Line10)**
that she finds the training sessions with her tutor very beneficial. It has helped her to execute her job well. She finds her tutor very supportive and understanding. He provides ample opportunities to master the skills needed for the job. She has a poor rapport with EO **(Line14)**

What they were

SA states that she is an orphan from the age of 10, and is responsible for the upbringing of her two siblings. SA informed me they (she and her siblings) used to survive on a social welfare grant. Her aunt and grandparents gave them a room to stay in and did the cooking and washing for them in lieu of their grant money. SA informed me that life has been tough for her and her siblings. They had no money and she had to work as a cashier over weekend and holidays to buy their **(Line20)**
Clothing. She has to ensure that her siblings do their homework, assisted with household cores, and played the role of both mother and father to her siblings. SA explains I had to grow up faster that the other youngsters of my age and take on adult responsibilities. She continues that in spite of being an orphan she was the deputy head girl at her school. SA describes that the day of her induction as **(Line25)**
deputy head girl as the proudest and saddest day in her life, I felt the presence of my mum around me during the induction, I cried a lot that night as I missed my mum, I wish I could just reach out and touch her. I felt cheated the other children had their parent in the audience and I had nobody. SA stated that she had enjoyed all subjects at school and it would be nice if the school focused more on preparing us for **(Line30)**
the world of work. I asked how they could do that. SA responded by teaching basic calculations in math that will help us with our line of work, having more practical based lessons in biology- we hardly did practical work in school as the bio syllabus was too long and we had to be prepared for our two biology papers,. SA continued that basic computer skills are vital and should be taught to all learners. SA **(Line35)**
state that the skills, knowledge, attitudes and values that she had acquired at school have been built upon and changed to become more complex.

Where they want to be

SA states this is more that just a job for me. It is my opportunity to financial independence from relatives, it's my opportunity to spoil my siblings with luxury items like chips and cool drink, it will assist me in funding my sibling's**(Line40)**
studies and improving the quality of our lives. I asked do you still live with your aunt and grandparents. SA responded I do, but I negotiated the amount of money that I contribute towards the upkeep of my family. SA said that she can't wait to have enough money saved to move away from her aunt and grandparents. After the completion of her in house training SA hopes to study further in either **(Line45)**
human resources management or project management. She plans to remain with this company as the EO has assured her of getting a job within the company in any of these two fields once she has a tertiary qualification. SA explains that she has a moral obligation to this company as this company has given her an opportunity to study when she had no access to study further **(Line50)** .

KM link

Who they are

KM is 19 years old and has been in the employment of the company for 18 months. He is being trained as a pharmacist assistant. KM has an obliging personality and has a friendly disposition. I asked KM about his progress with regard to his in house training. He stated that he hopes to finish his training by April. KM continued to say he enjoys the support of his mentor, who is always understanding and **(Line5)**
accessible to him whenever he needs assistance. KM states that all tutors are committed to the training program and they treat all 18.2's in the same way. I asked him why he had made that remark. KM explained that he knew that a "tension" exists in ABS where WD was concerned. KM stated that he was aware of the insecurity that ABS felt in the presence of WD. KM went on to explain that WD was truly**(Line10)**
a good and committed 18.2 who was always prepared to help the other 18.2 's when they encountered any difficulties with their theory. KM stated WD had assisted him with his modules and task when he was not coping and performing poorly. KM stated that he knows and has experienced first hand how his performance during the training session impacts with his relationship with his tutor and management. KM **(Line15)**
continued that when his performance was poor during the training session and he did not improve his performance in the next training session he had received a poor appraisal from the HRP and he did not get a performance allowance until he was on par with his training schedule. Km stated he was lucky not to be moved out of the production room like NA was**(Line20)** .

What they were

KM stated that he was an average pupil at school. He abided by the school rules and listened to his mother. His mother

was a single parent and was responsible for supporting her three children. KM was the eldest child. He did have much time for fun like the other pupils at school. He had to be serious so that he could pass and start working to help his mother. It was tough being in school as he was **(Line20)**
confronted by peer pressure. It was like a norm for pupils to drink, smoke, go clubbing and not worry about getting good results. KM recalls that the attitude amongst most pupils was what's the point in working hard when we cannot get jobs, our parents are poor and cannot afford to send us to study, our families live in debt, we are doomed to live in council houses. KM said he recalled his sports **(Line25)**
day in his grade 12 year vividly, it was a day that is etched in his memory forever. I asked why that is so. KM informed me that he was a prefect at his school and that his class pupils had decided to buy alcohol and bring it to school with them. They had planned to drink before the commencement of the sport and during the course of the sports. He said they had hid the alcohol in head girl's school bag. I asked **(Line30)**
why her bag. He responded no member of staff would have searched her bag as she was the head girl. I asked if they had done this previously. He responded the other pupils had done this many times and they never got caught. I asked so how was the sports day different from the other times. KM stated that it was common practice for pupils of his school to drink on Fridays. KM stated that it was the first time **(Line35)**
he had decided to consume alcohol as a result off overwhelming peer pressure. He stated that his class pupils had gathered on the ground on the pretence of setting chairs for the spectators. While they were "setting chairs" a cup of alcohol was passed to each pupil. The alcohol was consumed very discreetly and no one could tell they had consumed alcohol. KM explained that during the course of the 400m race for**(Line40)**
girls one of the participants from his class had collapsed on the ground. The paramedics attended to her and had found her to be drunk and drugged. Her parents were sent for and her little sister, who was also a pupil at our school , went to the principle and informed him that the grade 12 A class pupils has all consumed alcohol in school. The principal asked the teachers to conduct a full scale**(Line45**
investigation into this allegation on Monday morning. KM informed me that teachers have a way of extracting information from pupils hence they were all suspended for a week. KM stated that his mother was very upset with him and had ground him for the rest of the year. He stated it broke his heart to see him up so up set, it was like he had let her down and was a poor role model to his siblings. He stated after this **(Line50)**
incident he had stated working harder in school. There was an improvement in his marks. KM stated that the subjects that have assisted him the most with his in house training were biology and math. Biology assisted with some of the skills they were expected to master and math helped with basic calculations. KM stated that the skills acquired at school are basic skills that they are built upon and changed**(Line55)**
during their training. KM added but the skills developed at school served as a foundation for the development of other skills, without these basic skills we will not be able to learn and build on our existing skills. I asked what aspect of biology has helped you. KM replied the knowledge about biological compounds, human physiology, diseases, report writing, measuring accurately, using certain **(Line60)**
apparatus are some of the thing that have helped me in my training.

Where they should be

KM is confident that he will complete his training by April. He hopes to apply for an in house bursary to study further in the field of health and beauty. He has discussed this idea with the EO and she has encouraged him to apply for a bursary. KM states that he enjoys his job and likes working for this company as they offer **(Line65)**
opportunities to study further.

5. SM LINK

Who they are

SM is 20 years old and has worked for the company for 18 months. SM has an endearing personality. Her tutor is the EO. SM also shares a close working relationship with the EO and is unhappy with the support from the EO. SM reveals that WD is her unofficial mentor. He spurs her on when she battles with the formal and practical aspects of her training. WD often assists her with the formal tasks. **(Line5)** . SM stated that she was determined to complete her training by April.

What they were

SM stated off by saying that she her mother was the sole bread winner in her family. SM continued we experienced a patch of ill fortune during my matric year, my mum was involved in a taxi accident and had broken her hip and leg and was**(Line10)** retrenched. SM explained that she was absent from school on many days and had lost out on lots of instruction as she had to take care off her mum and accompany her mum to the clinic. I asked was there no one else who could go with your mum. SM responded my mum is a single parent and I am an only child. SM continued there was no money for her to study, even to attend a technikon as most of her mum **(Line15)** retrenchment package

went of medical bills. SM said she had passed with a matric exemption and had a 60% aggregate. I complimented her on her good results. SM stated that at school subjects like Biology, math and computers were important. Math assists with basic calculations, bio with many skills(identifying apparatus, measuring, writing reports, team work, handling apparatus, identifying compounds) and **(Line20)** computers with basic computer skills(word, emailing, internet search). I asked the skills, knowledge, attitudes and values that you have acquired via the school have they been developed, built upon changed. SM responded they have been built upon and changed so now we perform more skills in a professional manner and with confidence. SM states that the school subjects should be more suited to **(Line25)** the world of work. I asked what she means by this. SM responded they should have more excursions to industries so learner could see what type of job opportunities are available and what skills are needed for these jobs. SM continued not everybody can afford to study. So schools should have days when they invite people from industry to speak to pupils to show the pupils that there are opportunities available to**(Line30)** them.

What they should be

SM said she would use this training as a stepping stone for further qualification within this field. She would use the opportunity available to them to study further. The EO has started a trial project with the current batch of trainee NTEW, she has made available funding to a few promising NTEW to study further. SM indicated **(Line35)** to me that she thinks that WD will make a great tutor in the near future. I inquired why she thinks this. SM replied WD is patient and understanding and the EO has plans for him. **(Line38)**

KP link

Who they are

KP is 22 years old and has been working with the company for 4 years. He is in the second year of his training. I asked KP about the progress he had made with his house training. KP expressed he is troubled about the kind of mentoring he receives from the EO. KP said he feels overwhelmed with the formal and practical aspects of his training as very little time is allocated to him in the training session. I**(Line5)**
asked why he feels overwhelmed. KP responded that he is expected to learner too much in too short a space of time. KP continued he needs more time than the other 18.2's, it takes him longer to grasp certain concepts. KP states he is unlike WD. I asked why do you say that. KP replied that WD can grasp a concept easily and does have to study but he still does better than us in all his tasks. I envy people **(Line10)**
like that. They put in a minimum amount of time and get maximum results. I put in loads of time but still battle with my results.

What they have been

KP stated that his schooling days were punctuated with many suspensions. I asked how it was possible for him to have had many suspensions. KP responded that he had had at least one suspension every term. I enquired about the discipline **(Line15)**
policy at his school. KP responded that the discipline policy existed on paper and was never enforced by the office. I asked how this was possible. KP responded that the principal wanted to be friendly with the learners and that the teachers were one who had to enforce the code of conduct. I asked did the parents not object to the principal not enforcing the code of conduct or the discipline policy. KP responded **(Line20)**
that most parents who were serious about their children's education did object and had their children transferred to neighbouring schools that upheld the code of conduct. KP continued parents whose children got into trouble often did not complain about the principal as there was no record of their child's misdemeanours in the office. I asked KP to list some of the misdemeanours that he had been suspended **(Line25)**
for. KP responded he was suspended for attending house parties, fighting in school, drinking on the school premises and being involved in vandalism. He stated that he indulged in these activities due to boredom and not having an outlet to express my feeling. I asked why didn't you talk to your RCL reps in school or the teachers. KP replied I feel for my school teachers, they are over worked they barley cope **(Line30)**
with their jobs, they have no time to eat their lunch, their lunch break is spent doing ground duty and turning out worksheets and after school they attend meetings everyday. When I think back about my school days, I actually respect my teacher now, I realize that they have good intentions towards all their pupils and that they just want us to be successful in life. I appreciate my teacher know. I asked do **(Line35)**
you regret your behaviour. KP responded yes I do, if I could turn the clock I will not give my teachers such a hard time and would take note of their advice and try to be a better person.

I asked KP do you think that any of the subjects that you did at school prepared you for the world of work. KP replied no, I hated school, some of the thing**(Line40)**
I learnt will never help me in life, like Afrikaans. Biology helped a bit but it has too much content, the terms you are expected to learn are difficult, it could be more useful if teachers taught in differently, but they cannot do this, everything in biology is so exam driven. I asked what do you mean. KP replied teachers have to prepare learner for the

two biology paper, those teachers are always rushing **(Line45)**
through the syllabus. I asked did you find Biology to be a difficult subject compared to other subjects. KP replied yes it is, you are expected to learn so much content as compared to subjects like geography, (I did geog as well), and the papers are difficult with long sentences, lots of reading. KM continued Biology could be so beneficial if the content is reduced and it teaches more skills and practical. **(Line50)**

Where they want to be

I will complete my training here as I am so close to finishing. I regret the mistakes that I made in my life but I have taken longer that other to understand that I am responsible for my life. It is possible that all the alcohol that I consumed as a teenager has affected my learning. I now lead a healthy lifestyle, I exercise and I have given up my bad habits. I want to become a paramedic. I want to speak to the EO **(Line55)**
about this once I complete my training and seek her advice.

AnnexureE6 analysis of industry node

	Which actors do NTEW/MENTORS see as impacting on their practice?	**How do they interpret the effects of these actors?**	**What is their response?**	**Comment**
-Ls has provided us with key competencies needed in this industry- -Biology form the foundation of work place learning Practical work helps to manipulate apparatus, plan activities, write reports, measure accurately -Theory in it helps with knowledge required in WPL -there is a correlation between SKAVs developed via curriculum and SKAVs required for WPL -Assists with SKAV's in Work place learning-that are developed further in WPL -Assists in many skills such as identifying apparatus, measuring, writing reports, team work, handling apparatus, identifying compounds -Has advantage in terms of knowledge and laboratory skills, NTEW need an understanding of human physiology to assist them in coping with the module in our work place learning	Life sciences NTEW industry work place learning practical work science process skills curricula content curricula content world of work	-as a foundation/ platform for work place learning -as supplementary for work place learning - as useful	Affirmation of policy Affirmation of roles of schools in preparing learners for world of work Manipulation of apparatus, identification of apparatus, reading scripts, measuring, massing, writing reports, team work, identifying compounds, plan activity, knowledge	**As a building block for work place learning** Alliance formation with DoE/schools

<table>
<tr><td>-basic knowledge base is covered by curriculum
-curriculum provides basic knowledge required in industry
-Develops basic competencies in NTEW entering the world of work, this also depends on the type of school the NTEW attended</td><td></td><td></td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>-Curriculum should be more focused on preparing learners for world of work
-have more practical based lessons – we hardly did practical in school as the syllabus is too long, we had to prepare for two exam papers
Could be more useful if teachers taught it differently….everything is so exam driven
-too much content to learn, terms are difficult
-teachers have to prepare learners for two papers
-teachers are always rushing through the syllabus and are pressurized for good results by principal, parents and everybody
-curriculum must be linked to industries - have excursions to industries so learners and teachers could see what type of job opportunities are available and what Skills are needed for these jobs</td><td>curriculum
learners
world of work
curricula content
exams
teachers
teaching approach
industry
jobs</td><td>-as curriculum needing enhancement/ enrichment
-Non alignment of curricula content with regard to SKAVs needed in world of work
-hindrance to learning
- negative effect of exams on teaching/ learning
-lack of partnerships with schools (teachers/learners) at curricula level
-lack of contextualization of curriculum with industry</td><td colspan="2">Mediation focuses on the how and what of preparing NTEW during work place learning to complement/ develop SKAVs needed
“Should focus on employability SKAVs”</td><td rowspan="2">As a hindrance
Alliance formation with NTEW
Alliance formation with policy goals iro SKAVs development</td><td rowspan="2"></td></tr>
<tr><td>How
-EO designs WPL
-mentors mediate
-Internal evaluation
-external evaluator
-formal exams
-practical application</td><td>what Employability SKAVs
-knowledge and proficiency
-leadership
-maturity
-ability to cope with stress
-judgment
-work standard
-communication-written, verbal
-mental alertness
People interactive skills
-dependability
-telephone skills
-computer skills
-dead stock/expired stock disposal procedure
-storage and movement of stock
-questioning skills
-listening skills
-plans carries out procedure
-handling of materials safely
-recognizes technical problems in apparatus
-measuring,</td></tr>
</table>

				reading scales -Pipetting techniques -correct use of metler balance -calculations of ratios, mass -collecting and selecting materials -follow instructions - Accurate reading of meniscus - Compare sources of information -problem solving -share findings -ethical skills in lab work -honesty -social responsibility to team -tidying and clearing of stock -processing -compile stock register and ordering	