POLICY AND PRACTICE: AN ACTIVITY SYSTEMS' ANALYSIS OF A FURTHER DIPLOMA IN EDUCATION (TECHNOLOGY).

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Abstract

This research examines, within the interpretive paradigm, how emerging educational policy in an in-service educator education programme, namely, a Further Diploma in Education (Technology), is implemented and practiced by educators in the classroom. Technology is a new learning area in the South African curriculum that aims to develop learners' technological skills and promote the practical application of Science and Mathematics. Technology is seen as a way of developing a productive workforce that can design, realise and evaluate technological problems in a global economy.

Engeström's version of Activity Theory was used as the conceptual framework. Activity Theory focuses on 'activity' as a unit of analysis that captures the individual in context. This research focuses on the lecturers' and the students' actions in the programme, and the educators' and the learners' actions in the classroom. The research design was an eclectic case study consisting of two embedded cases within a single larger case namely, in-service educator education. Multiple single cases were selected within the two embedded cases. Trustworthiness and authenticity were addressed through the triangulation of data using multiple sources and methods of data collection. Data were analysed and interpreted in a hermeneutic-like process that emerged through gradual induction over time.

The findings of the research suggest that the in-service educator education programme did not promote the effective implementation of educational policy. Major challenges to the effective implementation of educational policy include: the formulation and implementation of an INSET programme during rapid educational policy change, the

under-preparedness and language difficulties of the participating educators that constrained policy implementation in the INSET programme and the classroom, the role of organisational rules in shaping the activities in the INSET programme and the classroom, and the broader community's contribution to resource constraints in the classroom.

This research suggests that the participating educators are not likely to be major change agents in the transformation of education in South Africa. This concurs with other research findings that suggest that educator education is a weak intervention incapable of overcoming the shortcomings of the educators' own personal schooling or the impact of work experience.

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List of Acronyms

ABET	Adult Basic Education and Training
AC	Arts and Culture
ACE	Advanced Certificate in Education
ADC	Academic Development Centre
ANC	African National Congress
CAD	Computer Assisted Drawing
CASME	Centre for the Advancement of Science and Mathematics Education
CEPD	Centre for Education Policy Development
COTEP	Committee of Teacher Education Policy
DoE	Department of Education in South Africa
DP	Duly Performed Certificate
EMS	Economic and Management Sciences
FDE	Further Diploma in Education
FET	Further Education and Training Band
GET	General Education and Training Band
HET	Higher Education and Training Band
HSS	Human and Social Sciences
INSET	In-service Educator Education and Training
LLC	Language, Literacy and Numeracy
LO	Life Orientation
MLMMS	Mathematics Literacy, Mathematics and Mathematical Sciences
NGO	Non Governmental Organisation
NQF	National Qualifications Framework
NS	Natural Sciences
OBE	Outcomes-based Education
PRESET	Pre-service Educator Education and Training
RUMEP	Rhodes University Mathematics Education Project
SA	South Africa
SAQA	South African Qualifications Authority
SO	Specific Outcomes
TECH	Technology
TIMMS	Third International Mathematics and Science Study
USA	United States of America
ZPD	Zone of Proximal Development

Glossary

Assessment – "involves the process of collecting and interpreting evidence of learner achievement" (S.A. DoE 1997f:3).

Assessment criteria – "are the criteria included in a unit standard designed to determine the achievement of specific and essential [critical] outcomes" (S.A. DoE 1997f:3).

Bands – "represent three broader groupings of levels on the NQF that have distinct characteristics similar to the notions of primary, secondary and tertiary, but integrating education and training" (S.A. DoE 1996:16).

Credit – "is the value assigned to a given number of notional hours of learning" (S.A. Government Gazette 2000:7).

Credit value – "is the value assigned to unit standards in order to facilitate comparisons between them as well as rules of combination for qualifications" (S.A. DoE 1997f:3).

Critical outcomes – "are generic, cross-curricular, broad outcomes that focus on the capacity to apply knowledge, skills and attitudes in an integrated way" (S.A. DoE 1997f:3).

Community – "comprises multiple individuals and/or sub-groups who share the same general object and who construct themselves as distinct from other communities" (The Centre for Activity Theory and Developmental Research 1998b:unpaged).

Competence – "involves the capacity for continuing performance within specified ranges and contexts resulting from the integration of a number of specific outcomes. The recognition of competence in this sense is the award of a qualification" (S.A. DoE 1996:15).

Division of Labour – "refers to both the horizontal divisions of tasks between the members of the community and the vertical division of power and status" (The Centre for Activity Theory and Developmental Research 1998b:unpaged).

Educator – "all those persons who teach or educate other persons or who provide professional educational services at any public school, further education and training institution or departmental office. The term includes educators in the classroom, heads of departments, deputy principals, principals, education department officials, district and regional managers and systems managers" (S.A. Government Gazette 2000:9).

Evaluation – "is the process whereby information obtained through assessment is interpreted to make judgements about a learner's competence" (S.A. DoE 1997f:3).

Field – "a means of organising the generation of standards and qualifications, their registration on the National Qualifications Framework, and assuring their quality" (COTEP 1998:unpaged).

Foundational competence – "where the learner demonstrates an understanding of the knowledge and thinking which underpins actions taken" (COTEP 1998:unpaged).

Learner – "refers to an individual who is participating in a learning programme with the purpose of achieving credits for standards and/or qualifications" (S. A. SAQA 2001:unpaged).

Learning Area – "refers to the fields of learning [in the schooling phase and the] knowledge, skills, values and attitudes that the learners have to develop" (Malan 1997:19).

Levels – "are the positions on the NQF where national unit standards are registered and qualifications awarded. These levels are arranged to signal increasing complexity in learning and to facilitate meaningful progression routes along career and learning pathways" (S.A. DoE 1997f:4).

Object – "refers to the 'raw material' or 'problem space' at which the activity is directed and which is moulded and transformed into *outcomes"* (The Centre for Activity Theory and Developmental Research 1998b:unpaged).

Outcomes – "are the results of learning processes, formal, non-formal or informal, and refer to knowledge, skills and attitudes and values within particular contexts. Learners should be able to demonstrate that they understand and can apply the desired outcomes within a certain context" (S.A. DoE 1997f:4).

Outcomes-based education – "is a flexible, empowerment-orientated approach to learning. It aims at equipping learners with the knowledge, competence and orientation needed for success after they leave school or have completed their training" (S.A. DoE 1997b:21).

Phases – "are distinguished within education in order to accommodate the various learning needs of learners at different stages of development" (S.A. DoE 1997f:4).

Portfolio – "is a deliberate, strategic and specific collection of learner work or evidence of learner work that demonstrates that learning has occurred and is linked to learning outcomes" (S.A. DoE 1997a:7).

Practical competence – "is the demonstrated ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action" (COTEP 1998:unpaged).

Reflexive competence – "in which the learner demonstrates ability to integrate or connect performances and decision-making with understanding and with an ability to adapt to change and unforeseen circumstances and explain the reasons behind these adaptations" (COTEP 1998:unpaged)

Rule – "refers to the explicit and implicit regulations, norms and conventions that constrain actions and interactions within the activity system" (The Centre for Activity Theory and Developmental Research 1998b:unpaged).

Role – "a character or part one has to play as part of one's work requirements. In the case of educators, these requirements are understood as having occupational, academic and professional dimensions which are spelt out in the practical, foundational and reflexive competences associated with the roles" (COTEP 1998:unpaged).

Specific outcomes – "are contextually demonstrated knowledge, skills and attitudes, reflecting essential [critical] outcomes" (S.A. DoE 1997f:4).

Subject – "refers to the individual or sub-group whose agency is chosen as the point of view in the analysis" of an activity system" (The Centre for Activity Theory and Developmental Research 1998b:unpaged).

Tool – "refers to physical and symbolic, external and internal mediating *instruments*, including both tools and signs" (The Centre for Activity Theory and Developmental Research 1998b:unpaged).

Unit Standard – "the smallest meaningful unit of assessment containing an integrated and applied competence. Registered statements of desired education and training outcomes and their associated assessment criteria together with administrative and other information" (COTEP 1998:unpaged).

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Chapter 1 The Context of the Research

1.1 Introduction

This research concerns the implementation of educational policy in an in-service educator education programme in South Africa and the practice of participating educators. In this chapter the aim and rationale for this research is provided followed by the structure of the thesis.

1.2 The aim of the research

The aim of this research is to gain an understanding of how emerging educational policy in South Africa is implemented in an in-service educator education (INSET) programme namely, a Further Diploma in Education (FDE) in Technology, and practiced by participating educators in the classroom in the school context. This research focuses on three levels of policy implementation. Firstly, the way in which the policy is conceptualised in the FDE. Secondly, the implementation of the policy in the teaching and learning activities in the FDE with special attention to the lecturers' and the students' (the educators participating in the FDE) actions. Thirdly, the way in which the educators implement the policy and their expertise gained from the FDE whilst teaching their learners in the classroom.

This research uses Activity Theory to investigate the implementation of educational policy. Within this framework the following research questions were asked:

1. How are conceptual and material tools used to implement educational policy by the lecturers and students in the FDE, and the educators and learners in the classroom?
2. How do the organisational rules governing the teaching and learning activities in the FDE and the classroom affect the implementation of educational policy?
3. What role does the broader community and/or individuals associated with the teaching and learning activities in the FDE and the classroom play in implementing educational policy?

4. How does the allocation of tasks and roles within the teaching and learning activities in the FDE and the classroom affect the implementation of educational policy?

1.3 The context of the research

This research began when the researcher was an Education lecturer at a Technikon in the Eastern Cape Province at a time when educator education was being re-conceptualised in line with the transformation of education in post-apartheid South Africa. Technology as a new learning area was being introduced in the school curriculum, as in other countries, due to economic, social and educational pressures (Medway 1989:1) within the parameters set by the South African Qualifications Authority (SAQA), the National Qualifications Framework (NQF) and Curriculum 2005.

One of the aims of Technikons is to promote Technology by means of instruction, research, development and technological services (Committee of Technikon Principals 1994:2). Technikons are expected to play a role in in-service educator education to re-educate qualified educators in the new Technology learning area.

The revision of the norms and standards of educator education in South Africa provided for a new direction in educational policy where educator education was now viewed as lifelong learning and ongoing professional development (COTEP 1998:xiv). The new direction in educational policy suggests that INSET is expected to play an important role in bringing about educational change and improving the practice of educators in the classroom.

Accepting the need for professional development in educator education, the importance of the role of the educator, as an innovative being who is capable of intelligent action, is implied. The educator as a key role-player in educational change was demonstrated in a national census on Technology Education in Canada, by Chinien, Oaks and Boutin (1995:unpaged), that showed that educators were the major change agents in the educational transition to Technology Education.

The link however between educator development and educational change is not necessarily straightforward. Fullen and Hargreaves (1992:2) argued that educator development neglected the educator as a person. They identified the lack of attention to differences among educators as a cause of ineffectiveness in most professional development programmes. Their view is supported by Feiman-Nemser (1990:229), who concluded that re-educating educators was a weak intervention incapable of overcoming the powerful influence of the educator's own personal schooling or the impact of work experience. Carter (1990:292) and Feiman-Nemser (1990:214) found that educators have preconceptions of what teaching is about. Similarly, Goodson (1985:360) demonstrated that educators have a subjective view of the practice of teaching within their subject areas with respect to the way the subject should be taught, the role of the educator and what might be expected of the learner (Praechter 1992:280).

Despite the different findings about the effectiveness of INSET, in South Africa where the majority of educators are either under-qualified or need to be retrained (EduSource 1995:unpaged), INSET is one of the few possible ways of improving educator practice. Several authors have investigated the factors contributing to the effectiveness of INSET. Guskey (1986:6) found that effective INSET provided educators with knowledge and skills that they perceived as potentially useful in expanding their capabilities, while Lambert (1988:667) argued that to be effective, INSET must do more than give educators information, demonstrate innovations and/or provide guided practice. There must also be opportunities for the educators to practice and receive feedback and coaching in the field. Boser and Daugherty (1994:unpaged) found, however, that little follow-up and evaluation of the effectiveness of in-service activities was occurring. These authors indicated that follow-up is important for two reasons: to ascertain whether the desired educational outcomes are being achieved; and to indicate if INSET actually made a difference in teaching practice.

The purpose of this research is thus to gain an understanding of how emerging educational policy in South Africa is implemented in an FDE (Technology) and practiced by participating educators in their classrooms in the school context.

1.4 The structure of the thesis

The overview of educational policy pertaining to this research is given in Chapter Two and includes a discussion on outcomes-based education that emerged in post-apartheid education in support of SAQA and the NQF. The rationale for the new Technology learning area, the meaning of Technology, technological literacy and Technology Education, international trends in Technology Education and the relationship between Technology, Science and Mathematics learning areas in the Senior Phase in Curriculum 2005 are also given. Finally, INSET educational policy is outlined.

The background to the establishment of the partnership between the Non Governmental Organisation (NGO) and the tertiary institution that conceptualised the FDE, and the subsequent partnership between the NGO branch that implemented the FDE is given in Chapter Three.

In Chapter Four the methodology for this research is discussed. Since the aim is to understand how educational policy is implemented in the FDE and in the classroom an eclectic case study method consisting of embedded cases within an interpretive paradigm is followed. The research methods are also outlined in this chapter.

The conceptual framework namely, Activity Theory, by which the data is analysed is presented in Chapter Five. An overview of the philosophical underpinnings and development of Activity Theory are sketched and its relevance to this research is presented.

Chapter Six outlines the aims of the research and explains the research process which includes the methods, data analysis process and aspects like trustworthiness, consistency, generalisability and research ethics.

The 'objects' of the FDE and the expectations of the students who enrolled for the FDE, are discussed in relation to educational policy in Chapter Seven.

In Chapter Eight, Nine and Ten the research findings concerning the implementation of the FDE are discussed while the research findings for the implementation of educational policy in the classroom are presented and discussed in Chapter Eleven.

In Chapter Twelve conclusions are drawn from the research findings and recommendations are suggested. The thesis concludes with suggestions being made for further research.

Chapter 2 Contextualising educational policy in South Africa

Different stakeholders from diverse backgrounds, concerned with educational policy issues, generated a great deal of debate prior to the 1994 South African democratic elections. There was frequent and justifiable criticism of the inadequacies of the apartheid educational system that led to deficiencies and discrimination in terms of qualifications and skills based on race, gender and geographical location. Education was in a crisis with the breakdown of the culture of learning, a lack of discipline and the absence of teaching in many schools (Samual 1993:249).

The democratic elections in 1994 also signalled the return of South Africa to the world economy and global markets. Globalisation and the rapid advances in technology, information and communication, have meant that people have been required to become 'skilled' within these fields. This has created an increased demand for learners and workers to be multi-skilled and flexible for South Africa to compete within a globally competitive world economy.

Educational transformation in South Africa was thus driven by "internal socio-political *transformation* imperatives" and "external economic *efficiency* imperatives" (Gultig 2000:43). The former is committed to redressing apartheid inequalities in education and training, and political power, while the latter recognises that South Africa has rejoined a globalised world economy and has become subject to rapid changes in knowledge and work and thus needs a skilled and productive work force that can be globally competitive.

In addition, factors such as the need to establish a democratic society and the need for greater accountability and transparency in the education and training process led to the realisation that South Africa needed to develop and implement a National Qualifications Framework (S.A. SAQA Bulletin 1997:3).

Before the NQF could become a reality, an authoritative body had to be established to oversee the development and implementation of the NQF, that in turn required policy formulation to ensure the registration and accreditation of national standards and qualifications within the framework.

2.1 The South African Qualifications Authority

In 1994 the African National Congress (ANC) policy framework for education and training, the discussion document on the National Training Strategy Initiative, and the Centre for Educational Policy Development (CEPD) Implementation Plan for Education and Training, laid the foundation for the South African Qualifications Authority (SAQA) Act. An inter-ministerial group drafted the NQF Bill that became law as the SAQA Act (No.58 of 1995). SAQA's function is to oversee the development and implementation of the NQF. The NQF will be discussed more fully in Section 2.2.

SAQA adopted the following fields before it could proceed with the establishment of the NQF:

01	Agriculture and nature conservation
02	Culture and arts
03	Business, commerce and management studies
04	Communication studies and language
05	Education, training and development
06	Manufacturing, engineering and technology
07	Human and social studies
08	Law, military science and security
09	Health sciences and social services
10	Physical, mathematical, computer and life sciences
11	Services
12	Physical planning and construction

S.A. SAQA (1997:8)

The development of a national, outcomes-based qualifications framework for South Africa aimed to reconstruct and develop the current education and training system into a system that reflected an integrated approach and addressed the learners' and national needs.

2.2 The National Qualifications Framework

The NQF represents learning pathways, locations of learning, and qualification levels that will enable learners to become part of a society of lifelong learners (Malan 1997:5). The NQF has eight levels grouped into three bands. Level One is the General Education and Training (GET) Band comprising Grade 0 to Grade 9 in the schooling sector and Level One in the Adult Basic Education and Training (ABET) sector. Level Two to Four is the Further Education and Training (FET) Band comprising Grade 10 to Grade 12 in the schooling sector and Level Two to Four in the ABET sector. Level Five to Eight is the Higher Education and Training Band (HET). These levels are represented diagrammatically [see Appendix A for the NQF Structure (S.A. DoE 1997b:30)].

This research is concerned with the GET Band at NQF Level One in the schooling sector and therefore focuses on the educational policy that was developed to meet the needs of education and training in the GET Band at NQF Level One.

An outcomes-based approach to education and training emerged in post apartheid South Africa within the parameters set by the SAQA and the NQF. This new approach was introduced in a context where historical inequalities continue to exist in a largely under-resourced system.

2.3 Outcomes-based education

An outcomes-based approach to education and training in South Africa emerged from "three historical antecedents". These are identified by Kraak:

> The first was the ascendancy of competency-based modular education and training in South African industry after 1985; the second was the adoption of Australian and British 'outcomes' models in the policy development work done by the ANC and COSATU [Congress of South African Trade Unions] since the early 1990s; and the third was the resurrection of the radical rhetoric of People's Education which first emerged in the heat of the struggle in the mid-1980s.
>
> Kraak (1998:38)

An outcomes-based approach to education accepts as its premise that outcomes should form the basis of all educational activities (including the description of qualifications), the development of curricula and the assessment of learners (Malan 1997:10). Spady (1994:18) contends that outcomes are "high quality, culminating demonstrations of significant learning in context". The use of the word 'demonstration' in the definition clearly indicates that an outcome is not a score or a grade, but the end product of a clearly defined process. These demonstrations are qualified as being:

- of high quality which implies that they must be thorough, effective and complete;
- culminating, that is, that learners are assessed at the end point of the learning experience and refers to what learners are able to do once the learning process is over;
- carried out within a significant or authentic context.

In South Africa, SAQA has accepted twelve broad, generic, cross-cultural and cross-curricular outcomes [see Appendix B for critical outcomes (S.A. SAQA 1997:7)] to contribute to "the full personal development of each learner and the social and economic development of the nation at large" (S.A. SAQA 1997:6). These critical outcomes are intended to direct teaching and learning at all levels on the NQF to ensure standardisation and efficiency in the education and training system.

OBE can be understood and implemented in different ways depending on the outcomes selected. Spady and Marshall (1991:68-71) identify three categories of outcomes, each with their own characteristics.

1. Traditional outcomes describe the demonstration of specific learner competencies in a particular subject at the end of small sections of work and are similar to what educators refer to as lesson objectives. Traditional outcomes-based education (OBE), strictly speaking, is not outcomes-based, as the starting point, in most cases, is the existing curriculum from which outcomes are derived. The outcomes are synonymous with traditional, content-dominated categories that do not relate to real life demands and

experiences. The demonstration of competence is limited to small segments of instructions.

2. Transformational outcomes represent the roles which competent, well-adjusted adults might expect to perform in society. Transformational OBE is a collaborative, flexible, outcomes-based, open-system, empowerment-orientated approach to learning. It aims at equipping all learners with the knowledge, competence and orientations needed for success in society after they have completed their training. Hence, its guiding vision is that of a competent future citizen. Success in the learning environment is of limited benefit unless the learners are equipped to transfer that success to life in a complex, challenging, high-tech future.

3. Transitional outcomes focus on knowledge, skills and values that students should have acquired, as well as on the students' ability to apply these in society. Transitional OBE lies between traditional and transformational outcomes-based education. It gives priority to higher-level competencies, such as critical thinking, effective communication, technological applications and complex problem-solving, rather than to particular kinds of knowledge or information. Broad attitudinal, affective, motivational and relational qualities are emphasised.

The Department of Education (S.A. DoE 1997f:6) contends that South Africa has embarked on transformational OBE while Spady and Marshall (1991:68) argue that South Africa has embraced transitional OBE since the Department of Education defines an outcome as "the results of learning processes whether formal, non-formal or informal" and a specific outcome as "contextually demonstrated knowledge, skills and values reflecting essential outcomes" (S.A. DoE 1996:15).

Based on the assumption that all learners can learn, OBE clearly defines what knowledge, skills, values and attitudes learners must demonstrate within a particular context. OBE in South Africa is meant to be learner-centred and results-orientated and this implies that (S.A. DoE 1997f:17-18):

1. what a learner is to learn is clearly identified. There is a clear focus on culminating outcomes of significance;
2. each learner is provided time and assistance to realise his/her demonstrated achievement;
3. each learner's needs are accommodated through multiple teaching and learning strategies and assessment tools;
4. each learner is provided the time and assistance to realise his/her potential.

In other words, educators and learners should focus their attention on what learners know and are able to do, making expectations and outcomes explicit, and also focus on learning as opposed to teaching.

Kraak (1998:40) argues that OBE "is not about expressing learning objectives in the form of outcomes" but rather OBE is about the "demonstration of competence" and two key features of this model are "performance standards and criterion-referenced assessment". OBE is thus an effective way of "coupling control with autonomy" (King and Evans 1991:73). These authors argue that control is exercised at the central level by those who set the exit outcomes while at lower levels, educators have autonomy to achieve these outcomes in any number of ways. The OBE challenge then becomes "a technical one of implementation" (p.74).

OBE requires a shift from the traditional approaches to curriculum development that focused on 'content' and what the educator must 'teach' to achieving predetermined outcomes or end products of the instructional process. OBE has been widely criticised for advancing the notion that knowledge is made up of discrete competencies that can be demonstrated and assessed separately. Brady (1996:14) cautions that educators run the risk of focusing on "training as a predominant method and over-testing". Hyland (1997:492) claims that outcomes form the basic minimum or lowest common denominator (synonyms such as 'sufficient', 'suitable' and 'adequate' are used) and these do not signify high levels of achievement. Planning for outcomes, however, can benefit educators who have to clarify and articulate their real intentions and thus are able to select appropriate methods and resources to meet the needs of a diverse group of learners.

Kraak argues that it is ironic that OBE has gained "credibility through its assimilation of the popular rhetoric of People's Education" (Kraak 1998:21) whilst many people regard OBE as behaviourist and technicist. A behaviourist and technicist approach to education falls within Habermas's (1972) 'technical educational paradigm' where knowledge is viewed as instrumental and the curriculum is a product that dictates practice towards reaching pre-determined outcomes. In this paradigm, the curriculum serves to teach learners knowledge and skills required for the workplace.

The establishment of the NQF and the implementation of an outcomes-based approach to education led to the development of a more appropriate curriculum in the GET Band to replace the previous apartheid era curriculum and to meet the challenges facing learners in a democratic South Africa and the 21st Century.

2.4 Curriculum 2005

The new curriculum, referred to as Curriculum 2005 because it was due to be phased in nationally by 2005, includes key principles such as: integration and progression, relevance, participation and ownership, accountability and transparency, learner-centred approach, flexibility, critical and creative thinking, inclusion of learners with special educational needs, and quality, standards and international comparability (S.A. DoE 1997b:7).

Curriculum 2005 is applicable in the GET Band that comprises the Foundation Phase (Grade 0 to Grade 3), the Intermediate Phase (Grade 4 to Grade 6) and the Senior Phase (Grade 7 to Grade 9). This research focuses on the Senior Phase and, therefore, this is elaborated on in respect to educational policy in Curriculum 2005.

2.4.1 The Senior Phase

The Senior Phase is the last phase of the three phases in the GET Band. The learning content is less contexualised and more abstract since it is claimed, "the learners are increasingly able to reason independently of concrete materials and experience ... [and] are able to engage in open argument and are willing to accept multiple solutions to single problems" (S.A. DoE 1997g:unpaged).

In Curriculum 2005, eight learning areas were identified on NQF Level One in the GET Band, each with its own specific outcomes; each specific outcome with its own assessment criteria; and each assessment criteria with its own performance indicators. The recently established Ministerial Review Committee has subsequently criticised Curriculum 2005 for "the complexity of the curriculum design" and "obtuse use of language and proliferation of new terminology" (S.A. DoE 2000:15). The Review Committee recommended a more streamlined curriculum that excludes the sixty-six specific outcomes, assessment criteria, phase and programme organisers, range statements, performance indicators and expected levels of performance.

The **eight learning areas** (with the abbreviations in brackets) in the GET Band are:

- Language, Literacy and Communication (LLC)
- Human and Social Sciences (HSS)
- Technology (TECH)
- Mathematical Literacy, Mathematics and Mathematical Sciences (MLMMS)
- Natural Sciences (NS)
- Arts and Culture (AC)
- Economics and Management Sciences (EMS)
- Life Orientation (LO)

Technology is one of the eight learning areas in the Senior Phase and is also a new learning area in Curriculum 2005. Since this research is concerned with Technology, this learning area will be elaborated on together with the two learning areas Natural Sciences and Mathematics, from which Technology draws.

2.4.2 Technology - A new learning area

The Department of Education in South Africa (DoE) puts forward a number of arguments for the introduction of Technology as a new learning area in the GET Band (S.A. DoE 1997h:3-4).

Firstly, the DoE argues that the quality of life in a culture or society is directly related to its members' ability to solve problems through the design, production, appreciation and appropriate use of technology. In addition, Technology Education will enable learners to learn to solve problems and design new technologies and generally enhance the quality of life of its citizens.

Secondly, the DoE contends that Technology Education will allow learners to develop the necessary skills to understand and meaningfully engage in a rapidly changing world. Problem-solving, appropriate technical skills, individual resourcefulness and the ability to learn new skills and adapt are examples of skills that will help make learners independent citizens, prepared for lifelong learning and better equipped to enhance the capacity of the South African economy.

Thirdly, Technology Education has an important role to play in improving learners' understanding of career opportunities in industry and of the social environment of the world of work, according to the DoE. The DoE argues that Technology Education can support, supplement and focus career development and education at school by exposing learners to workplace realities. Accordingly, Technology Education should assist learners to recognise that Technology in the world of work is affected by and impacts on, most aspects of human interaction. The DoE believes that Technology Education will expose learners to a range of different values and attitudes and encourage them to form, change, defend and challenge their own values and attitudes and those of others.

Lastly, the DoE argues that Technology Education has a special role to play in preparing school leavers for entry into the economy and the world of work and will provide opportunities "to acquire and practice a range of skills including leadership, teamwork, critical thought, change management and other skills" (S.A. DoE 1997h:30).

The primary interest of Technology Education in South Africa according to the S.A. DoE (1997h:10) is to develop learners' abilities to creatively apply their understanding of content knowledge (facts), theory (sets of hypotheses which serve to connect known facts into more or less logical and coherent patterns so that predictions can be made), and technical knowledge (practical techniques and process skills) in order to design, realise and evaluate solutions to technological problems.

2.4.2.1 What is meant by Technology?

Technology is a popular 'buzzword' used by people to mean different things depending on their context. To some, Technology is an artifact, to many it is an activity that is defined by human action and to others it is equated with computers (Boser 1993:unpaged). Technology has been with us since the Stone Age, so named for the materials humans used to modify their environment. The Renaissance or Industrial Revolution is named for the influence it had on society at the time. Likewise, we live in a Technological Age because of the rapid changes that technology is having on individuals, society and the environment.

Many definitions of Technology may be found in the literature and authors like Shield (1996:unpaged) caution that in defining Technology, one must bear in mind factors like culture, occupation, geographic location and education that colour perceptions.

Khumalo (1998:100) considers technology from an ideological perspective. This author cautions that Technology has been assigned different meanings by different people in South Africa because of their different cultural and socio-economic backgrounds. He says that black people in South Africa see Technology as frightening and threatening compared to other racial groups who welcome it. He attributes this to apartheid education propagating vocational and technical training for people who could not cope with the academic stream. "This distorted view of technology has impacted negatively on the psyche of the majority of Blacks in this country. Black people are superficially aware of fields of study in the realm of technology but are unaware of the fundamentals central to them" (Khumalo 1998:100).

Olson (1997:384) views Technology from a cognitive perspective and refers to Technology as a cognitive process that emphasises developing problem-solving skills that involve abilities in design or technological capability. He does not however refer to what effect technological practices may have on the environment.

Wright, Isreal and Lauda, as cited in Wicklein (1997:unpaged), refer to Technology as a practice used to develop, produce and use artifacts and the impact that these practices have on humans and the natural world. These authors suggest that

Technology is concerned with knowledge, understanding and doing as a cultural process. In other words, implementing ideas through a process of developing products while taking into consideration the environmental impact of implementing these ideas.

Although there is no consensus on the meaning of Technology, rapid technological advances and a shift towards global world economies in recent years have resulted in noticeable changes in the type and level of skills required in the workplace. In South Africa and other countries, social and educational pressures have led to an increasing importance being placed on Technology Education (Medway 1989:3). Chinien *et al* argue that as countries move towards international information-based economies, a well-educated and technologically literate workforce will be a key ingredient for the countries to maintain their competitiveness (Chinien *et al* 1995:unpaged).

In the policy documents for all three phases in the GET Band, the DoE defines Technology as "the use of knowledge, skills and resources to meet human needs and wants, and to recognise and solve problems by investigating, designing, developing and evaluating products, processes and systems" (S.A. DoE 1997d,e,g:unpaged). This definition is broad and embraces Technology as a cognitive, problem-solving process, a cultural practice and an economic process.

2.4.2.2 What is meant by technological literacy?

Given that there is no consensus on the meaning of Technology, it is not surprising that there is no consensus on the meaning of technological literacy (Chinien *et al* 1995:unpaged). Technological literacy may be interpreted from a narrow skills-based technical perspective or from a broader perspective where the 'cultural' and 'social' are central to the concept.

Gentry and Csete (1991:25) favour the cultural and social perspective. They refer to technological literacy as a multi-dimensional construct that relates to the understanding of "the creation, utilisation and behaviour of adaptive systems including tools, machines, materials, techniques and technical means and the behaviour of these elements and systems in relation to human beings, society and the environment".

Olson (1997:385) concurs with this perspective and points out technologies as systems are ancient and have their own cultural form and logic. He argues that, rather than be guided by stereotypical images of male dominated and science-based technologies as the form of technological capability we seek, we should recognise that Technology has a broader base in culture. This author suggests that one way of seeing through the current stereotype (which has overtones of power and control) is to look at the manner in which women have sustained culture through their contribution to Technology.

Lewis (1996:48) gives a narrow, skills-based interpretation of technological literacy as opposed to the broader socio-cultural perspective. He argues that 'skill' is the variable that is the primary measure of technology's effects and is a valued currency perceived as being demonstrable, empirically verifiable and transferable and the quality of the skill one possesses can be measured by predetermined competency standards.

Spenner proposed two conceptions of skill: (a) skill as a substantive complexity, referring to "the level, scope and integration of mental, interpersonal, and manipulative tasks in a job" and (b) skill as autonomy-control, referring to "discretion available in a job to initiate and conclude action, to control the content, the manner and speed with which tasks are done" (Spenner 1985:135).

Dreyfus and Dreyfus, as cited in Engeström (1987:216) describe five stages of skill acquisition related to computer use. These authors outline a linear internalisation process from 'novice' to 'expert', but fail to take into consideration how people learn from experience, particularly when facing "complex probabilistic tasks", according to Brehmer, as cited in Engeström (1987:218) who argues that:

> ... people do not learn optimal strategies from experience even if they are given massive amounts of practice. The reason why the subjects fail to improve in these tasks seems to be that they lack the necessary schemata to help them understand and use the information provided by their experience. Rather than using the appropriate statistical schemata, subjects use an inappropriate causal or deterministic schemata ... The characteristic of probabilism is, of course, not manifest, but it has to be inferred ... for a person with the firm belief in the deterministic characteristic of the world, there is nothing in his experience that would force him to discover that the task is probabilistic and to give up the notion of determinism ... in short, probabilism must be invented before it can be detected.
>
> Brehmer, as cited in Engeström (1987:218)

Today, the definition and acquisition of skill rest with the employers, whose need for skills in terms of their imperative to compete in the global economy has captured the attention of policy makers. These skills, that employers are said to want, are a set of attributes or criteria for labour market entry that are independent of jobs. Employers are demanding that workers "operate in complex environments, that is, environments characterised by ill-defined problems, contrary information, informal collaboration, and abstract, dynamic and highly integrated processes" (Westera 2001:75).

According to Lewis (1996:50), we are witnessing a revolution in the workplace, due to the introduction of Technology, the consequence of which is that the nature of work is changing, with jobs either being transformed or becoming obsolete. He argues that these changes have important human and societal consequences. At a human level, some may find that Technology makes their jobs more complex and satisfying, others may find themselves bewildered and incompetent. Still, others may find that their work has become less challenging and some may pay the ultimate price of job loss. At the societal level, balancing productivity gains due to technology with technological unemployment, lower paid jobs and worker alienation has become a challenge.

There is widespread acceptance, according to Hyland (1997:173), that employees of the future will require a range of 'flexible' or 'transferable skills', however, Sieminski, as cited in Hyland (1997:173), suggests only a minority of core workers in the new flexible work force of the future will require high-level skills. Black

(1998:unpaged) raises the concern that national strategies are now moving towards an emphasis on education that develops broadly applicable skills or competences, referred to as 'generic' or 'core' competences. Pursuit of these competences raises problems about whether the capacity to transfer such competences across contexts can be learned.

Current beliefs in South Africa that technological literacy is empowering and that a technological workforce will enhance our ability to compete globally have generated a momentum for Technology Education. Olson (1997:389) argues that if Technology Education is to impact favourably, then a shared vision of the roles and goals of Technology Education must be established between policy makers and practitioners.

2.4.2.3 What is meant by Technology Education?

Not only do different people define Technology differently, there is also little agreement on what is meant by Technology as a subject. Authors use the terms Technology, Technological Education and Technology Education interchangeably and confusion arises when authors do not make explicit to which 'subject matter' they are referring.

Technology Education may be viewed as a cognitive process that leads to change through understanding content knowledge from different disciplines. Authors like Wicklein (1997:unpaged) and Black (1998:unpaged) support this approach by referring to Technology as a subject closely aligned with Engineering and its related disciplines, while authors like Hansen (1993:unpaged) and Satchwell and Dugger (1996:5) refer to the subject Technology as "Technology Education" or "Technological Education" which draws from different disciplines, for example Art, Design, Psychology, Engineering, Mathematics and Science. Hansen (1993:unpaged) asserts that Technology Education is a long-standing but evolving subject that embraces all Technological Education programmes from Kindergarten to High School while Satchwell and Dugger (1996:11) refer to Technology Education as "ranging from basic programmes reflective of early manual arts to 'state of the art' Technology Education programmes".

Another perspective of Technology Education that involves cognitive processes that Kimbell (1994:72) refers to as a 'technological capability', involves the process of understanding a task, responding to it by making proposals, understanding materials, tools and processes, making products and evaluating them critically against the need of the user. A technological capability is recognised as a complex process that involves both the end result and also the route taken to get there. The concept 'technological capability' may be represented diagrammatically [see Appendix C for diagrammatic representation of a 'technological capability' in Ter-Morshuizen 1994:14].

Wright, Isreal and Lauda's, as cited in Wicklein (1997:unpaged), understanding of Technology Education suggests that, while it is possible to recognise how something functions and, therefore, have a technological comprehension, it is necessary to implement a solution to a problem before a claim can be made for technological capability. The capability, therefore, requires further attributes that may be described as problem-solving skills to give life to this comprehension. These authors argue that knowledge is constantly changing and expanding, as are the demands made upon technologists to meet new challenges.

A common argument in support of designing and making, according to Shield (1996:unpaged), is the theory that people learn by 'doing'. Therefore, through involving learners in practical project work, they enhance their technological understanding by applying theoretical principles to 'real life' situations. This philosophy of 'thought in action' has theoretical justification and active learning approaches are an accepted part of education in many countries. In Technology Education designing is at the heart of 'doing' and there is a growing awareness that modeling forms an important part of designing. Another important aspect of designing is visualisation and the ability to communicate information graphically in two and three dimensions. Recent advances made in computer software have meant that modeling and graphics packages are now fairly inexpensive and readily available on the market whereas before they could only be afforded by industry.

An active learning approach in Technology Education often involves problem-solving in the teaching-learning situation to teach learners how to "*find, evaluate* and *use* what they need to know" to achieve particular goals (Biehler and Snowman 1991:423). The rationale for using this approach is to prepare learners to adapt to rapid changes in a technological society. Problem-solving skills are valued in the work place because people with these skills are seen to be adaptable and effective in situations that are unpredictable and where the task demands change (Resnick, as cited in Biehler and Snowman 1991:424).

Three common types of problems are discernable in a problem-solving approach: well-structured problems, ill-structured problems and issues (Biehler and Snowman 1991:444). These authors suggest a five-step process to solving most problems, namely: realise that a problem exists, understand the nature of the problem, compile relevant information, formulate and carry out a solution, and evaluate the solution (Biehler and Snowman 1991:444-451).

Unlike Kimbell (1994:72), McDonald (1997:3) refers to the 'technological process' as the integral part of solving technological problems. Potgieter (1998:4) also refers to the technological process and combines the approaches of Kimbell (1994) and McDonald (1997) when he refers to everything that happens in a particular technological endeavour as the technological process that requires technological capabilities, but he does not say what these capabilities are. Potgieter (1998:4) describes the technological process as a set of consecutive steps that are followed in a cyclical fashion with feedback loops. He says that an understanding of this process is fundamental to the acquisition of technological literacy.

There is no consensus among authors on the number of steps in the technological process. There is agreement, however, that 'designing, making and evaluating' occurs during the technological process. Potgieter (1998:4) states that there are six steps in the technological process: "analyse, design, plan, make, evaluate and present", while McDonald (1997:3) lists four steps namely "analysis, design, planning and making, and evaluation". Not only do the number of steps vary, but there is also disagreement on whether the process is 'linear', 'circular' or 'interactive' [see Appendix D for linear and circular models in Ter-Morshuizen (1994:12-16) and a process model in Garratt (1991:9)].

Olson (1997:384) cautions that what is currently taken to be a 'capability' is overly influenced by how scientific capability is defined, and each, in turn, is overly influenced by theories of mental functioning. Boser (1993:unpaged) concurs and quotes the Commission on Pre-College Education in Mathematics, Science and Technology (1983:v) as stating that "problem solving skills and scientific and technological literacy ... [are] the thinking tools that allow us to understand the technological world around us".

In spite of the need to help students gain critical technological literacy skills, Chinien *et al* (1995:90) argue that schools in Canada have failed to emphasise this area. Wicklein (1997:unpaged) argues that the lack of focus on curriculum content has created a disjointed approach to the study of Technology that has diminished the impact that Technology has had on education and society.

Kimbell *et al,* as cited in Shield (1996:unpaged), caution that evaluation of process learning is difficult. These authors say that inevitably the objective of the educator very quickly becomes the production of well-presented evidence, as opposed to the enhancement of the understanding of the process by learners. Shield (1996:unpaged) raises the concern that if skills like analysis, synthesis and evaluation are to be developed as the prime function of the learning experience then we must understand how to promote these in the classroom.

Kramer (1996:14) and McDonald (1997:2) express another approach to Technology Education that offers a critique of the cognitive perspective. These authors argue that Technology Education is not a discipline, but rather a way of life through which life skills are acquired. These authors view Technology Education as an approach to teaching that they regard as 'real education'. Boyer (1983:304) concurs and refers to the study of Technology Education as encompassing the history of man's tools, how Science and Technology have joined, and the ethical and social issues Technology raises. He contends that the urgency is not 'computer literacy', but "the need for students to see how society is being reshaped by our inventions, just as tools of earlier eras changed the course of history" (Boyer 1983:304).

Wright (1992:68) contends that Technology Education is concerned with (a) the processes used by practitioners (technologists) to develop new technologies *that may include* critical thinking and problem-solving, (b) the area of technology which represents the accumulated knowledge and practice of specific technological applications, and (c) the impact technology has on society and the environment.

Olson (1997:388) suggests that it is clear from classroom research that Technology Educators intend to do more than teach problem-solving capabilities. Educators have an image of work life in mind when they are working with their learners, according to Barnett (1994:52), Kozolanka and Olson (1994:210) and McCormick, Murphy and Hennessy (1994:15). These authors argue that educators establish microcosms that are suffused with values, and the values are connected to virtues that educators think their learners ought to have, both as civilians and as workers. In addition, these authors contend that educators have images of civil life in mind that cut across specialised roles to encompass the whole person and that all school subjects are taught with these images in mind.

The S.A. DoE (1997h:12) refers to Technology Education as "technological knowledge and skills, as well as technological processes, and involves understanding the impact of technology on both the individual and society". They argue that learners need to master technological capabilities in Technology Education and state that "technological capability involves the learner's ability to engage in technological activities and develop optimum solutions to technological problems" (S.A. DoE 1997h:12) that should involve:

Designing that includes being able to

- Identify and define needs
- Acquire and interpret information
- Employ information and other resources to develop possible solutions and strategies to meet identified needs
- Work within constraints and to specify design criteria
- Continuously refine and improve initial design ideas

Making which includes being able to

- Plan and organise the production/manufacture process
- Work efficiently, safely and to a high standard in realising the design

Evaluating which includes being able to

- Continuously test and evaluate the solution against design criteria
- Present/market the solution to the target market

S.A. DoE (1997h:13-14)

The S.A. DoE's (1997h:13-14) approach to Technology has both a 'cognitive skills' and a 'socio-cultural' perspective to address the "*efficiency*" and "*transformation*" imperatives (Gultig 2000:43) facing South Africa. Technology Education is seen to have several aims, which are given different priorities in different countries.

2.4.2.4 International trends in Technology Education

De Vries, cited in Black (1998:unpaged) identifies several approaches to Technology Education that Black argues may be underpinned by one or more of the following purposes: economic, intrinsic value, citizenship, and Marxist philosophy. The approaches are:

1. A technical skills approach – seeking emphasis on craft skills
2. A craft approach – in which cultural and personal value of the combination of manual skill, aesthetic sensibility and traditional design is to be preserved
3. A technical production approach – seeking emphasis on skills appropriate to modern mass production and its control and organisation

4. An engineering production approach – seeking the school subject as a preparation ground for specialist technicians and engineers in tertiary education
5. A modern technology approach – which looks at the nature of 'work' in the next century and focuses strongly on information technology
6. A science and technology approach – in which it is assumed that these two subjects are or ought to be, studied in close association with each other
7. Concentration on design – seen by some as a central concept in the study and practice of technology
8. A problem-solving emphasis – focusing on an understanding of the nature of social needs in the definition of 'problems' and of the need for a cross-disciplinary approach to tackling issues
9. A practical capability approach – emphasising personal and active involvement of learners tackling realistic problems to offset the passive and receptive ethos of the school education
10. Emphasis on the technology-society nexus – which calls for the study of technological innovation as a driving force for social change and of its interaction with other forces that also drive change

Policy in some countries is mainly driven by one of these approaches, whereas in others there is an attempt to adopt several of them in concert. South Africa has adopted several of these approaches, namely, a technical skills approach, a craft approach, a Science and Technology approach, a problem-solving approach, a practical capability approach and the emphasis on the Technology-society nexus.

Each approach sketched above is implemented within a particular curriculum model. The curriculum model serves as a framework for diagnosing the purpose of a curriculum or the ideology of the educator, and a way to implement the desired goals. In South Africa, the curriculum model focuses on outcomes-based education and fits appropriately with the purpose of the approaches adopted for Technology by the Department of Education mentioned in the previous paragraph.

Different countries have adopted different curriculum models or a combination of more than one model to suit their particular aims for Technology and Technology

Education. Four countries' approaches to Technology and Technology Education, namely: Australia, England and Wales, New Zealand and the United States of America (USA) will be briefly reviewed.

2.4.2.4.1 Australia

In Australia, 'Technology' is used as a generic term for all the technologies people develop and use in their lives. "It involves the purposeful application of knowledge, experience and resources to create products and processes to meet human needs" (Australian Education Council 1993:3). Technology was designed as a key learning area, specified in four strands to include (1) Designing, Making, and Appraising; (2) Information, (3) Materials, and (4) Systems. Technology according to Black (1998:unpaged), unifies the areas of materials, design and technology, design graphics, food and textiles, keyboarding, information technology, media studies, applied power technology, agriculture, Computer Assisted Drawing (CAD), and electronics.

The Australian curriculum model has a 'design, make and appraise' focus for teaching Technology and Science. This model involves working from a design brief to design an object or solution to a problem. As in the United Kingdom, the new approach to Technology Education is being implemented at the same time as changes in the curricula of other subjects, notably Mathematics and Science, according to Black (1998:unpaged).

2.4.2.4.2 England and Wales

In England and Wales, the Technology curriculum has been developed over the past 25 years and is moving away from making artifacts to developing skills in fashioning wood and metal (Black 1998:unpaged). This author states that a new unified subject was created in 1990 under the new National Curriculum for all learners between 5 and 16 years, where former educators of craft, design and technology, home economics, business studies, and art and design have come together to implement the new subject.

According to Black (1998:unpaged), there was criticism of the new unified subject from engineers who feared that the broad range and early emphases on social needs and on discussing the nature of Technology would weaken the teaching of skills of design and construction. The curriculum was then revised, and it is now narrower in scope, with a clear emphasis on designing and making, with the aims in relation to technology and society removed (Black 1998:unpaged).

All learners have to work in both nonresistant materials (textiles and food) and resistant materials (wood, metal and plastics) up to the age of 14 years, after which there is more flexibility. The tasks in which students are engaged include designing and making of products, focused practical tasks set up to develop particular knowledge and skills, and the study of existing artifacts by testing, disassembling, and evaluating them. Although science and technology educators collaborated prior to the introduction of the new curriculum, these links have been significantly reduced because educators have been overburdened with the demands of the new curriculum (Black 1998:unpaged).

Technology in England and Wales reflects a cognitive focus with an emphasis on designing and making skills which are considered very important aspects of Technology.

2.4.2.4.3 New Zealand

The New Zealand Ministry of Education (1995:5) clearly differentiates between Technology and Technology Education. The Ministry defines Technology as "a creative purposeful activity aimed at meeting needs and opportunities through the development of products, systems or environments. Knowledge, skills and resources are combined to help solve practical problems. Technological practice takes place within, as influenced by, social contexts" (New Zealand Ministry of Education 1995:5). Technology Education in New Zealand is a "planned process designed to develop students' competence and confidence in understanding and using existing technologies and in creating solutions to technological problems. It contributes to the intellectual and practical development of students, as individuals and as informed members of a technological society", according to the New Zealand Ministry of Education (1995:7).

The aim of Technology Education would suggest educational, personal, cultural, environmental and economic aims. Educationally, students are motivated to participate in purposeful activities, enabling them to apply and integrate their knowledge and skills from many learning areas in real and practical ways. The main aim of the Technology Education curriculum is: technological knowledge and understanding, technological capabilities, and technology and society (New Zealand Ministry of Education 1995:9).

These three areas are spelt out in some detail in eight levels to reflect progression in learning within these three strands. The curriculum also emphasises activities in a range of nine contexts, for example, home, community, business and industry and a range of seven areas of technology, for example, biotechnology, electronics and control, food, information and communication, materials, production and process, and structures and mechanisms. There is a strong emphasis on project work interweaving the strands, the contexts, and the areas. A list of skills is specified and linked with the learning areas of language, mathematics, science and social sciences, the arts, and health. It is envisaged that Technology will be part of the curriculum throughout all 13 years of compulsory schooling.

The New Zealand approach embraces aspects of the cognitive, cultural and economic perspectives that may be considered a 'balanced' and contextually sensitive approach to Technology. The New Zealand model according to Black (1998:unpaged) goes further than other countries in encouraging schools to adopt a cross-curricular model for the implementation of Technology.

2.4.2.4.4 The United States of America

Technology Education in the USA has evolved from industrial arts. Early industrial arts goals according to Zuga (1989:unpaged) included statements about career exploration, consumerism, and skills development with the emphasis on prevocational study. Current goals for Technology Education reflect the influence of the industrial arts, but more emphasis is being placed on industry and technology, the teaching of cognitive and effective intellectual processes, and the role of consumerism, which is represented as a critical preparation for citizenship (Zuga 1989:unpaged).

This author contends that the interest in creating good consumers of industrial products and responsible citizens with respect to the environment signals a change in the direction of the subject matter (Zuga 1989:unpaged). In addition, she argues that statements about the value of problem-solving have changed from simple statements about the ability to plan and construct projects, to more global statements about the role of problem-solving in society. The Technology model in the USA reflects an economic perspective with a strong emphasis on environmental concerns.

One consequence of globalisation, according to Mahomed (1996:2) is the "resultant smooth facilitation of educational policy borrowing". This is the case in South Africa where the National Department of Education has adopted the "designing, making and evaluating" Australian model for Technology in South Africa. The 'design, make and appraise' model focuses on cognitive skills such as knowledge and problem-solving with less emphasis being placed on the cultural and environmental concerns.

2.4.3 Technology in the Senior Phase

The S.A. DoE (1997g:unpaged) defines the learning area of Technology as " the use of knowledge, skills and resources to meet human needs and wants, and to recognise and solve problems by investigating, designing, developing and evaluating products, processes and systems".

Technology in a rapidly changing world, is more than teaching skills required to replicate or use existing technologies (S.A. DoE 1997h:3). The DoE argues that critical skills of resourcefulness, problem-solving, the ability to learn both individually and in groups and the ability to conceptualise and design novel solutions are as important as technical dexterity in securing and sustaining the viability of our economy (S.A. DoE 1997h:3).

In Curriculum 2005, the rationale and specific outcomes for Technology in all three phases are the same. The difference lies in the assessment criteria, range statements and performance indicators [see Appendix E for Senior Phase document]. In the Senior Phase, the Technology learning area seeks to develop in learners:

- An ability to solve technological problems by investigating, designing, developing, evaluating as well as communicating effectively in their own and other languages and by using different modes;
- A fundamental understanding of and ability to apply technological knowledge, skills and values, working as individuals and as group members, in a range of technological contexts;
- A critical understanding of the inter-relationship between technology, society, the economy and the environment.

S.A. DoE (1997g:unpaged)

The Natural Sciences and Mathematics are also learning areas in the Senior Phase in the GET Band. Since the Natural Sciences and Mathematics are linked to Technology, brief reference will be made to the rationale given in Curriculum 2005 (S.A. DoE 1997g) for these learning areas to provide insights into how these learning areas complement one another. The relationship between Technology, Natural Sciences and Mathematics will be discussed thereafter.

2.4.4 The Natural Sciences in the Senior Phase

In the Senior Phase, the rationale for the Natural Science learning area is stated as follows:

> The Natural Sciences, comprising the physical life, and earth sciences, involve the systematic study of the material universe – including natural and human-made environments – as a set of related systems. A variety of methods, that have in common the collection, analysis and critical evaluation of data, are used to develop scientific knowledge. Learners need to know that Science is a human activity, dependent on assumptions which change over time and over different social settings.
>
> The development of appropriate skills, knowledge and attitudes and an understanding of the principles and processes of the Natural Sciences
>
> - Enable learners to make sense of their natural world;

- Contribute to the development of responsible, sensitive and scientifically literate citizens who can critically debate scientific issues and participate in an informed way in democratic decision-making processes;
- Are essential for conserving, managing, developing and utilising natural resources to ensure the survival of local and global environments; and
- Contribute to the creation and shaping of work opportunities.

> In the view of its potential to improve the quality of life, learning in the Natural Sciences must be accessible to all South Africans. The investigative nature of knowledge acquisition in the Natural Sciences should be mirrored in education. Learners should be active participants in the learning process in order to build a meaningful understanding of concepts which they can apply in their lives.
>
> S.A. DoE (1997g:unpaged)

Mathematics is the other learning area closely linked to Technology and is one of the eight learning areas in the Senior Phase in the GET Band.

2.4.5 Mathematics in the Senior Phase

In the Senior Phase, the Mathematics learning area is defined as follows:

> Mathematics is the construction of knowledge that deals with qualitative and quantitative relationships of space and time. It is a human activity that deals with patterns, problem-solving, logical thinking etc. in an attempt to understand the world and make use of that understanding. This understanding is expressed, developed and contested through language, symbols and social ineractions.
>
> S.A. DoE (1997g:unpaged)

The rationale for the Mathematics learning area is given as:

> Mathematics literacy, mathematics and the mathematical sciences as domains of knowledge are significant cultural achievements of humanity. They have built both utilitarian and intrinsic value. All people have a right to access to these domains and their benefits. These domains provide powerful numeric, spatial, temporal, symbolic, communicative and other conceptual tools, skills, knowledge, attitudes and values to:

- Analyse;
- Make and justify critical decisions; and
- Take transformative action, thereby empowering people to:
    - Work towards the reconstruction and development of South African society;
    - Develop equal opportunities and choice;
    - Contribute towards the widest development of the society's cultures;
    - Participate in their communities and in the South African society as a whole in a democratic, non-racist and non-sexist manner;
    - Act responsibly in protecting the total environment;
    - Interact in a rapidly-changing technological global context;
    - Derive pleasure and satisfaction through the pursuit of rigour, elegance and the analysis of patterns and relationships;
    - Understand the contested nature of mathematical knowledge; and
    - Engage with political organisational systems and socio-economic relations.

S.A. DoE (1997g:unpaged)

Several authors and the Department of Education (S.A. DoE 1997h:26) have referred to the relationship between Technology, Science and Mathematics.

2.4.6 The Relationship between Technology, Science and Mathematics

Early literature challenges the linear model of the Science-Technology relation (Faulkner 1994:426). This model implies that scientific discoveries lead to technological inventions and that Technology is a responsive activity of applying Science. Historically, technologies as solutions to specific problems arising out of needs, have generally predated the rigorous, generalised explanations of scientific principles on which the technologies are based, e.g. levers were used before the description of their mechanisms (S.A. DoE 1997h:26).

The S.A. DoE (1997h:26) argues that Technology precedes Science because we interact with (live in, investigate and encounter needs in) our environments. They suggest that we design and produce artifacts (technologies) to solve the problems arising from our needs. As needs change and are modified, we require generalised theories of our environments that can be applied to various circumstances. The S.A. DoE (1997h:26) concludes that "a need for a rigorous science emerges".

Faulkner (1994:426) reviews literature that suggests the emergence of the research-based chemical, electronic and the more science related technologies have indicated that Science and Technology have become increasingly "intimate endeavours" during this century. While this may be so, certain differences between the two are still discernible. These differences are indicated in Table 1.

Table 1. The difference between Science and Technology
(JISTEC 1996 Conference, as cited in S.A. DoE 1997h:26)

Science	Technology
Aim is to explore natural phenomenon and reach ever improving understanding	Aim is to design and develop new products which solve new or existing problems
Curiosity driven	Need or want driven
Works with idealised, simplified pictures of the world	Works in the real, complex, human world
Internal criteria of truth, accuracy and the ideal	Criteria are solutions which are effective, efficient and within acceptable tolerances and standards
Looks for universal knowledge	Looks for optimal solutions for specific situations

Mathematics also plays a central role in dealing with the problems presented by the environment and the S.A. DoE (1997h:27) argues that in order to investigate and solve problems, approaches to collecting, handling and communicating qualitative and quantitative data are required. The S.A. DoE (1997h:27) suggests that a particular problem emanating from the environment needs to be modelled mathematically and is intimately related to the scientific knowledge with which it is dealing. The mathematical model is solved through the application of known mathematical techniques e.g. equations, formulae and expressions. The solution then is interpreted back into the real life situation. "Mathematics thus becomes the vehicle for attaining a generalised, abstract and rigorous science while also being fundamental to problem solving" (S.A. DoE, 1997h:27). DeVries, as cited in Olson (1997:384), cautions that many design problems tackled by learners seem to be in a vacuum and lack a relationship with the broader aspects of Technology or Science and Mathematics in society.

There is a similarity in the processes used to carry out investigations in Science, Mathematics and Technology (Sage 1996:69) and this author gives the following analysis of these processes as shown in Table 2.

Table 2. The analysis of the investigation process in Mathematics, Science and Technology (adapted from Sage 1996:69)

MATHEMATICS	SCIENCE	TECHNOLOGY
Identify a problem and plan an investigation	Making a prediction or propose a hypothesis and plan an investigation	Identify the need and plan the development of a solution
Build a mathematical model and select the mathematics to use	Design a suitable investigation to test the prediction and collect evidence to test the validity of the hypothesis	Carry out research and generate a range of designs and/or solutions to meet the identified need
Analyse the model using mathematics	Carry out the investigation and/or collect the evidence	Implement the optimum solution
Interpret and validate the model	Interpret the data collected and check the validity of the procedure or hypothesis	Evaluate the effectiveness of the solution

The S.A. DoE (1997h:28) argues that while promoting the creative application of Mathematics and Science in a practical setting, Technology Education also brings down artificial barriers between these subjects by drawing from subjects across the curriculum to support learners' attempts to solve real problems. Barak and Waks (1997:187) contend that in Israel, Technology Education has led to closer links between Science and Mathematics in recent years and that the Technology curriculum in Israel has incorporated more basic mathematical and physical science concepts related to analysing and designing technological systems.

The S.A. DoE (1997h:28) believes that Technology can motivate learners to learn Mathematics and Science "because it shows how these subjects are relevant to everyday life". Motivating learners to learn Mathematics and Science is not going to be easy given that South Africa is "far behind the rest of the world in terms of skills in the field of mathematics, science and technology" (Van Schoor and Clifford, 1998:131). These authors cite the results of the Third International Mathematics and Science Study (TIMSS) where South Africa, the only African country that competed, was placed last out of fourty-one countries in both Mathematics and Science.

Black (1998:unpaged) contends that the aim of Technology Education to develop 'practical capability' speaks for a subject that is far from 'academic' in the traditional sense. Rather, it strives to bring together practical action with the development and the use of knowledge and skills that other school subjects may supply. Treagust and Rennie (1993:unpaged) observe that there is a move away from aligning technology with the 'trade' or 'technical' subjects and an effort to place it central to the curriculum.

One of the consequences of the artificial division of education into 'academic' and 'vocational' education is that 'academic' is seen to be more valuable than 'vocational' since abstract knowledge is suffused with symbols and deals with 'thinking' that is valued over 'making' (Olson 1997:384). This author argues that capabilities that are enhanced by 'symbol-rich' subjects like Science and Mathematics are seen to have correlates in mental activities, and Science is said to strengthen those general mental capabilities. The prestige in society of Science in particular, and abstract thinking in general, helps maintain the hierarchy. Olson (1997:384) suggests that this is so because vocational educators aspire to enhance the prestige of the subject through stressing the cognitive elements in 'making'. He argues that Technology Education strives for curricular status through convergence with Science and Mathematics and this manifests in an overemphasis on the design component in Technology.

The recent introduction of new educational policies to transform the educational system in South Africa has meant that educator education has had to reassess its position in view of the transformation process. The revision of Norms and Standards for Teacher Education was overseen by the Committee on Teacher Educational policy (COTEP) and took place within the parameters set by SAQA, the NQF, OBE and Curriculum 2005. Educator education in the Mathematics, Science and Technology learning areas has been identified as a priority since the majority of educators in these learning areas are either under-qualified or are in need of retraining (COTEP 1996:2).

The process of implementing educational change to improve the quality of professional practice will be difficult given the shortage of resources and vast backlogs from the apartheid education system that have to be redressed. The dissemination of new ideas and practices will probably depend largely on effective in-service (INSET) and pre-service (PRESET) educator education programmes. PRESET involves general and formative education of educators through formal courses leading to nationally recognised qualifications. Historically INSET has been implemented in different ways in South Africa:

> 1. short, often ad hoc, courses aimed at improving the skills of unqualified teachers without qualification or salary benefits;
> 2. longer formalised programmes – like Further Diplomas in Education – aimed at improving the skills, qualifications and salaries of teachers;
> 3. formalised post-graduate programmes – like Bachelor of Education degrees – qualifications aimed, primarily, at improving the educational understanding, qualifications and salary levels of teachers.
>
> COTEP (1998:128-129)

Since the focus of this research is on a longer formalised INSET programme where participants are awarded a qualification, only educational policy pertaining to INSET will be discussed.

2.5 In-Service educator education

'Professional growth' and 'professional development' are terms used interchangeably with 'INSET' and 'staff development' by authors who attach different meanings to the terms to suit their own notion of what education is. In addition, INSET has been defined in different ways depending on the emphasis that is placed on it, in terms of its plan or design (Bagwandeen and Louw 1993:19).

A definition that adopts INSET as expanding the professional and personal education of the educator as "in-service education and training, may, in the most general sense, be taken to include everything that happens to the teacher from the day he *[sic]* takes up his first appointment to the day he retires which contributes, directly or indirectly, to the way in which he executes his professional practice" is used by Henderson (1977: 163).

Still another definition regards INSET as a series of activities where the "teachers can extend their personal education, develop their professional competence and improve their understanding of educational principles and techniques" and is used by the James Committee, as cited in Bagwandeen and Louw (1993:19).

In the South African context INSET is described as:

> The whole range of activities by which serving teachers and other categories of educationalists (within formal school systems) may extend and develop their personal education, professional competence, and general understanding of the role which they and the schools are expected to play in their changing societies. INSET further includes the means whereby a teacher's personal needs and aspirations may be met, as well as those of the system in which he or she serves.
>
> Hartshorne, as cited in Bagwandeen and Louw (1993:20)

Bagwandeen and Louw (1993:20) contend that in the final analysis, INSET should "help teachers to improve the quality of education in their schools; help teachers to be more effective in their posts and enjoy job satisfaction; to prepare teachers for promotion; and to provide teachers with higher qualifications".

INSET provision falls into the HET Band on NQF Level Five to Eight depending on the type of INSET programme offered and the Institution offering the programme. All INSET qualifications have to be registered with SAQA by 30 June 2003 to be accredited. Registration may take one of three forms: (1) Unit Standards, (2) Qualifications based on Unit Standards, or (3) Whole Qualifications.

Educator educational policy changed to a competence-based approach in 1996 with the introduction of outcomes-based education. The new direction of educational policy in South Africa focuses on lifelong learning with the ongoing development of professional competences where educators think, adapt, innovate and implement professional practice "through informed and self-assured decision-making" (CEPD, as cited in COTEP 1998:130).

Further changes occurred in educator educational policy after 1996. The competence-based approach changed from two broad categories of competences (general and specific competences) in 1996 to focusing on six, then seven roles and their applied competences in 1998 and 2000 respectively. The change in focus is in line with the outcomes-based approach to education adopted by SAQA and the NQF and Curriculum 2005. The policies in COTEP (1996), COTEP (1998) and S. A. Government Gazette (2000) will be explored briefly.

2.5.1 INSET Policy in 1996

The Norms and Standards for educator education were declared national policy by the Minister of Education, Professor Bengu, on 8 September 1995 (S.A. Government Gazette, 1995 No. 1387) and came into effect in January 1996. This policy represented a "process, output approach to teacher education" (COTEP 1996:1). As with outcomes-based education, the means are variable, but the ends or outputs are specified.

The broad aims for educator education were articulated in COTEP (1996:6-13) as:

> 1. The fundamental aim of teacher education is to educate and train teachers to teach effectively in order to facilitate learning, recognising the full complexity of the South African context. This will require teachers to teach in accordance with the enunciated goals of education and the particular ethos of the school.
> 2. Teacher education should result in the students being able to demonstrate the ability to apply, extend and meaningfully synthesise various forms of knowledge.
> 3. Teacher education should enable the prospective teacher to develop skills ... these skills are not exercised in isolation but interact holistically.
> 4. Teacher education should enable student teachers to develop those values, attitudes and dispositions which advance, e.g. the development of individuals towards a cultivated intellect.
> 5. Teacher education should prepare teachers to be active and reflective members of the teaching profession, e.g. teacher education should develop students who are committed to their pastoral, contractual, legal and administrative responsibilities.
>
> COTEP (1996:6-13)

The objectives for educator education were described in terms of general competences related to knowledge, skills and values/attitudes/dispositions and specific competences for specific phases of education such as primary and secondary education. The instrument for the appraisal of teacher education institutions (COTEP 1996:33-43) and a detailed outline of the structure of teacher education programmes (COTEP 1996:44-124) were also given in the policy document. Of particular interest to this research is the policy provision for a Further Diploma in Education. COTEP stipulated this as follows:

(a) Provision for particular needs

Further Diplomas in Education may be offered to provide for the following identified particular needs in Education:

(i) Re-education of already qualified teachers to teach in disciplines in which they were not originally qualified.

(ii) To equip selected teachers for posts in the management and administration of education and other specialised fields of practice.

(iii) To equip teachers to provide for the educational needs of children with various handicaps or to provide for the specialised need of pupils in normal education.

(iv) To equip teachers to optimise the potential of their pupils.

(v) To equip teachers with a knowledge of contemporary developments in education and appropriate teaching strategies.

(b) Minimum admission requirements

Teachers who are in possession of at least three years of approved professional teacher education, evaluated as M+3 Category C.

(c) Training Institution

Education may be offered only by institutions accredited for the purpose of further teacher education.

(d) Duration of the course

At least one year full-time or the equivalent thereof by correspondence and/or part-time education.

(e) Content of the course

(i) At least five credits which are based on one of the following patterns: 2-1-1-1, or 2-2-1, (the numbers denote credit levels) or;

(ii) At least four credits if three of the credits are in one or more of the subjects Physics, Chemistry, Mathematics, Botany, Zoology and Computer Science and are based on one of the following patterns: 2-2, 2-1-1 or 1-1-1-1.

(iii) Further Diplomas in Education to provide for the specialised needs of children, must include in the five prescribed credits at least the psychological and methodological aspects applicable to the field of specialisation as well as Remedial Education. The remaining credits must cover the field of specialisation effectively.

(f) The diploma awarded will be known as a Further Diploma in Education.

COTEP (1996:118-120)

Interestingly Technology is listed in COTEP (1996:131) as an approved subject for educator education programmes for the pre-primary and primary school phase, but not for the secondary school phase, while Science and Mathematics are listed in both school phases.

The Norms and Standards for educator education underwent a further revision with the publication of *The Norms and Standards for Educators* by the Technical Committee on the Revision of Norms and Standards for Educators (COTEP 1998) that was adapted and declared national policy by the Minister of Education, Professor Asmal on 4 February 2000 (S.A. Government Gazette, 2000 No. 20844).

2.5.2 INSET Policy in 1998

The cornerstone of the COTEP (1998) policy was the six "roles" and their "applied competences" [see Appendix F for COTEP 1998:68-80] and the provision for the ongoing professional development of educators. COTEP (1998) refers to teachers as "educators" unlike COTEP (1996) that made reference to "teachers". An "educator" is referred to in the COTEP glossary as:

> Any person who teaches, educates or trains other persons or who provides professional educational services, including professional therapy and education psychological services, at any public school, further education and training institution, departmental office or adult basic education centre.
>
> COTEP (1998:unpaged)

The term "role" is defined in the COTEP glossary as follows:

> A character or part one has to play as part of one's work requirements. In the case of educators, these requirements are understood as having occupational, academic and professional dimensions which are spelt out in the practical, foundational and reflexive competences associated with the roles.
>
> COTEP (1998:unpaged)

The term "applied competence" is referred to in the COTEP glossary as:

> Applied competence is an over-arching term for three inter-connected kinds of competence. Practical competence is the demonstrated ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action. Practical competence is grounded in foundational competence, where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken; and it is integrated through reflexive competence, in which the learner demonstrates the ability to integrate or connect performances and decision-making with understanding and with an ability to change any unforeseen circumstances to explain the reason behind these adaptations.
>
> COTEP (1998:unpaged)

The titles of different qualifications also changed in COTEP (1998) and have been linked to different NQF Levels. The FDE is situated at NQF Level 6b with a credit value of 480 credits [see Appendix G for the FDE on the NQF in COTEP 1998:36]. The FDE is considered "a further specialised qualification usually following a diploma" (COTEP 1998:83). The requirements for the FDE are outlined in COTEP (1998) [see Appendix H for the FDE requirements in COTEP 1998:88-89]. INSET in COTEP (1998) has been reconceptualised to focus on assisting educators in three areas to improve their practice: keeping pace with rapid changes in knowledge, lifelong professional development, and integrating 'theory' and 'practice'.

The Norms and Standards for Educators that became policy in S.A. Government Gazette 2000, No. 20844 in February 2000 derive from COTEP (1998) and "the cornerstone of this Norms and Standards policy is the notion of *applied competence* and its associated *assessment criteria*" (S.A. Government Gazette 2000:10).

2.5.3 INSET Policy in 2000

A number of differences between policy in COTEP (1998) and S. A. Government Gazette (2000) emerged:

- The first difference is the inclusion of the role of 'assessor' as a separate, seventh 'role' with its associated 'applied competences' [see Appendix I for the S. A. Government Gazette 2000:13-22).
- Secondly, the FDE underwent a name change to the Advanced Certificate in Education (ACE).
- Thirdly, certain qualifications changed while qualifications and credit values and levels on the NQF were simplified.
- Fourthly, the purpose of qualifications has been clearly linked to an integrated approach to assessment of competence or exit outcomes.
- Fifthly, teaching subjects are no longer prescribed and qualifications have been clearly demarcated into Foundation Phase (Grade R to Grade 3), Intermediate Phase (Grade 4 to Grade 6), Senior Phase (Grade 7 to Grade 9) and Further Education (Grade 10 to Grade 12).
- Sixthly, articulation and progression have been strengthened to promote lifelong professional development.
- Lastly, the term "educator" was redefined as:

> All those persons who teach or educate other persons or who provide professional educational services at any public school, further education and training institution or departmental office. The term includes educators in the classroom, heads of departments, deputy-principals, principals, education department officials, district and regional managers and systems managers.
>
> S. A. Government Gazette (2000:9)

The purpose of the ACE (previously referred to as the FDE) in South Africa Government Gazette (2000) is similar to that of the FDE in COTEP (1998) and is described as:

> A qualification to accredit further specialised subject/learning area/discipline/phase competence, or a new subject specialisation, or a specialisation in one or more of the roles as an advanced study intended to 'cap' an initial or general teaching qualification. Through this qualification learners will be prepared to embark on a course of study at NQF Level 7. It must therefore, include appropriate demands in terms of rigour.
>
> S. A. Government Gazette (2000:24)

The introduction of Technology as a new learning area in Curriculum 2005 has necessitated a rapid growth of curriculum materials, and the training of educators who are mostly unfamiliar with the nature of the subject. Partnerships between tertiary education institutions and NGO's are one of many possible ways of offering educator education where successful participants receive a formal qualification. An example of this kind of partnership developed between a University and an NGO in the Eastern Cape Province in South Africa with the conceptualisation of a Further Diploma in Education (Technology) that will be discussed in the following chapter.

Chapter 3 The Conceptualised Further Diploma in Education (Technology)

The FDE research for this thesis was conducted within the partnership between an NGO and a University with two campuses, one in City A and one in City B. In order to protect the participants the NGO and the University are not named: information regarding the citation of documents from the NGO and the University may be obtained from the author.

In this chapter the context within which the partnership between the NGO and the University was established and the Further Diploma in Education (Technology) conceptualised, will be briefly sketched.

3.1 Background

In 1994 two former apartheid-era 'homelands', the Transkei and the Ciskei, were incorporated into the Eastern Cape Province when the new provincial boundaries in South Africa were defined prior to the democratic elections. The Eastern Cape Province is one of the most impoverished provinces in South Africa. The province has vast rural areas and isolated villages and a number of smaller urban areas where a large percentage of the population is unemployed. The Eastern Cape Province possibly has borne the brunt of apartheid education policies particularly in the poor rural areas in the former 'homelands'. Resources are largely inadequate to address infrastructure problems like the shortage of classrooms and the lack of water and electricity supply, as well as the lack of basic equipment like desks and chairs in many schools.

The majority of educators in South Africa were subjected to the apartheid education system and as a result may either be under-qualified or need to be retrained. Table 3 shows the qualifications of educators in the Eastern Cape Province by race with a matriculation certificate (M) and the number of years of post matriculation study. For example +2 indicates 2 years post matriculation study.

Table 3. **Educator qualifications in the Eastern Cape Province**
(From EduSource 1995/03:unpaged)

RACE	CATEGORY					
	(M+2)	%	(M+3)	%	(M+4)	%
African	22,755	46	22,259	45	4,175	8
Coloured	1,504	29	2,300	44	1,405	27
Indian	0	0	33	37	57	63
White	67	2	686	17	3,187	81

Within this context, the process of implementing educational change to improve the quality of education in the Eastern Cape Province will be difficult and the dissemination of new ideas and practices will largely depend on effective INSET programmes. In an attempt to address this concern, the University and the NGO collaborated to conceptualise and implement a Further Diploma in Education (Technology) as described further.

3.2 The partnership between the NGO and the University

The partnership that was established between the NGO and the University in City A will be briefly sketched since this partnership had a bearing on the partnership that developed between the NGO branch in City B and the University in City A, which is the focus of this research.

3.2.1 The NGO

The parent NGO had its origins in Russia in the 1880s and developed into the largest Non Governmental Organisation in the world and a leader in education and technological training. While adhering to the principles of community empowerment through development and commitment, its vision is to provide people "with the necessary learning tools and skills for job creation and employment" (NGO *Education for Life* no date:unpaged).

The NGO established itself in South Africa in 1936 to raise funds for bursary schemes "to enable disadvantaged students to obtain the necessary and relevant education to fill crucial demands in the economy" (NGO *Education for Life* no date:unpaged). The NGO played an important role in promoting Technology Education and developing policy for Technology Education in South Africa through its involvement in the Technology 2005 Pilot Project commissioned by the South African Government and the South African Department of Education.

In May 1993, the NGO started a Science and Technology Project "to spearhead quality Technology Education" in South Africa (NGO *Education for Life* no date:unpaged). Initially the NGO trained educators in the Gauteng Province and later expanded its influence by establishing branches in the Western Cape Province and the Province of KwaZulu-Natal. The NGO and its branches focused on promoting Technology Education in primary and secondary schools and providing high quality INSET courses to enable practicing educators to teach Technology effectively (NGO *Kick-Start* no date:unpaged).

The NGO received funding from the D.G. Murray Trust to establish a branch in the Eastern Cape Province and subsequently established three branches in partnership with two Universities in the Province (Interview NGO Executive Manager 6 September 1999). The NGO then approached the Head of the Education Faculty at the University in City A to establish a branch to offer INSET Technology Education in the region.

3.2.2 The University in City A

In September 1993, the newly recruited NGO Executive Manager (who hailed from the Eastern Cape Province) and the NGO Executive Director based in the Gauteng Province engaged the Head of the Education Faculty at the University in City A in exploratory discussion with the view to establishing an NGO branch in the city. The original idea was for the NGO branch to establish a partnership with the University and a private school to offer a Diploma in Technology that the University would acredit.

Discussions between the University management and the NGO Executive Manager followed with the University management supportive in principle of the NGO's initiative. In his proposal to the Board of the University Faculty of Education to motivate for the establishment of the new Further Diploma in Education (Technology), the Head of the Education Department states:

> After a survey of other possible locations the [NGO] identified the Department of Education together with [a private school] as the center in the Eastern Cape where they would most prefer to establish and be involved in Technology Education programmes. This selection was made against stiff competition from other institutions. One of [NGO] aims with the venture is job creation in the Eastern Cape.
>
> University (no date:1)

The University Senate accepted the Faculty of Education's proposal on 28 October 1994 (University Dean, Faculty of Education 1994 pers. com). In 1995 further discussion followed to develop the Diploma and draw up a memorandum of agreement between the three institutions concerned. In accordance with the agreement, The University would develop a one-year full-time equivalent Further Diploma in Education (Technology) hereafter referred to as the FDE. The stakeholders at the NGO branch and the University Education Faculty interpreted educational policy in the process of conceptualising the FDE.

3.3 The conceptualised FDE in City A

The stakeholders at the NGO branch in City A and the University Education Faculty interpreted the educational policy whilst conceptualising the FDE. In keeping with the provision of INSET for the "re-education of already qualified teachers to teach in disciplines in which they were not originally qualified" (COTEP 1996:118), the stakeholders agreed that the FDE entrance requirement would be an M+3 qualification (COTEP 1996:119) and would consist of four Modules namely, Technology, Science, Mathematics and Education. Technology was thus conceptualised as Technology Education or Technological Education that draws from different disciplines such as Science and Mathematics according to Hansen (1993:unpaged) and Satchwell and Dugger (1996:5).

The stakeholders envisaged the four Modules being closely integrated and the FDE syllabi (1998) [see Appendix J for the University FDE syllabus (1998)] being implemented to reflect independent, co-operative and practical work (Interview University Lecturer 20 September 1999). The inclusion of Science and Mathematics in the FDE complied with the requirement that Science and Mathematics form an integral part of the Technology learning area as articulated in educational policy documents (S.A. DoE 1997h:26, 1997d:8-25) and met the requirements for the course content of "at least five credits" (COTEP 1996:119). In addition, the conceptualised FDE satisfied the requirements for the duration of study of "at least one year full-time or the equivalent thereof by correspondence and/or part-time education" COTEP (1996:119). The contact hours allocated for the FDE are shown in Table 4.

Table 4. Contact hours for FDE Modules over 1 and 2 years
(Interview University Lecturer 20 September 1999)

MODULE	HOURS OVER 2 YEARS	HOURS OVER 1 YEAR	% OF FDE
Technology	300	150	50
Mathematics	120	60	20
Science	120	60	20
Education	60	30	10
TOTAL	600	300	100

The NGO paid the University lecturers to develop the course material for the Science, Mathematics and Education Modules while the NGO's Regional Director/branch manager developed the course material for the Technology Module. The NGO also contracted lecturers from the University to present the Science and Education Modules and a lecturer from the Rhodes University Mathematics Education Project (RUMEP) was contracted to present the Mathematics Module.

The FDE students attended lectures for the Science, Mathematics and Education Modules at the University. The Regional Director/branch manager presented the Technology Module at the private school (where he was previously employed) and where the NGO branch was based.

At the end of 1996 discussions with the the University lecturers in consultation with representatives from the private school and the NGO's Regional Director/branch manager, led to the decision to accommodate the NGO branch in the University

Faculty of Education and not at the private school, as was the case in the original agreement. It was also agreed that the University would be responsible for the Science, Mathematics and Education Modules whilst the NGO branch would be responsible for the Technology Module. At this time the NGO's Regional Director/branch manager joined the staff of the University and a new branch manager was appointed.

The University then signed a second memorandum of agreement with the NGO's newly appointed branch manager to jointly offer the FDE. The sections in the memorandum of agreement relevant to this research state that:

> The University enters into an agreement with [NGO], who are educating teachers in Technology Education, in the undermentioned diploma course subject to the following conditions:
>
> 1.1 That the curriculum offered by the University will have the following minimum course requirements:
>
> - Technology Education: Physical Science: Mathematics and Education as approved by the Minister of National Education.
> - The University will be responsible for the teaching of the courses Physical Science, Mathematics and Education subject to section 2.1.
> - [NGO] will be responsible for the teaching of the course in Technology Education (including Basic Computer Literacy) subject to section 2.1.
> - The above responsibilities will be subject to change by mutual written agreement.
>
> 1.2 The syllabuses for the courses will contain the minimum contents as specified by the Senate of the University for the said courses and as approved by the National Department of Education ...
>
> 2.1 The personnel used for the teaching of the courses for which the University will be responsible will be full or part-time lecturers of the University or other competent individuals contracted through the University.
>
> 2.2 The personnel used for the teaching of the courses for which [NGO] will be responsible will be accredited as lecturers by the University after deliberation with [NGO] as to their abilities, qualifications and experience ...
>
> 4.1 The selection of students for admission to and enrolment at the University for the diploma will be done jointly by the University and [NGO] provided that the usual entry requirements and registration procedures set by the University are applicable. Such students also qualify for subsidy grants from the State to the

University on the basis of the formula laid down for university subsidies. Any subsidy paid by the State for the students will be retained by the University.

4.2 The diploma students will be required to register with the University. The students will be required to pay the normal application and registration fees. All the students will also be bound by any other University regulations which are normally applicable to students ...

4.4 The University regulations for this diploma will apply fully to the students and the University will have the final decision in this regard. The diploma will be awarded jointly by the University and [NGO], [NGO] being acknowledged on the diploma in an appropriate manner (e.g. "In co-operation with the [NGO]").

4.5 Tests and examinations will be conducted in accordance with the examination regulations of the University and under the authority of the Faculty of Education of the University.

4.6 As members of the University, these students will enjoy the same privileges with regard to the use of the infrastructure of the University (such as library, sports and recreation facilities) as other students of the University ...

6. NGO will be responsible for the collection and administration of all fees. Fees paid by the students for the diploma course will be retained by NGO.

University (1996:1-6)

A similar agreement was signed between the NGO's branch manager in City B and the University in City A when an NGO branch was established in City B in 1995.

The requirements of COTEP (1994, 1996, 1998) and the S. A. Government Gazette (2000) within the context of the NQF, Curriculum 2005 and OBE (discussed in chapter 2) guided the implementation of the FDE by the NGO branch in City B in conjunction with the University in City A.

3.4 The FDE in City B

The NGO established a branch in City B after negotiating with the City B Technical College to lease a building on its premises at a nominal rental for a period of five years ending in November 2000 (Interview NGO branch manager 10 June 2000). Negotiations with the University Education Faculty in City A resulted in a memorandum of agreement being signed between the NGO branch manager in City B and the University in City A.

This agreement was similar to the agreement signed between the NGO branch and the University in City A. While the agreements between NGO and the University were essentially the same, the FDE was implemented differently in City A and City B in five key areas.

Firstly, the NGO branch manager in City B presented the Technology Module and initially contracted individuals to present the Science, Mathematics and Education Modules. Later an Education lecturer was appointed by the University in City A to offer the Education Module at the University campus in City B. The Science and Mathematics Modules were offered on a reciprocal basis by lecturers from the Centre for the Advancement of Science and Mathematics Education (CASME) and RUMEP respectively who had offices at the University campus in City B. In 1999 the NGO branch manager in City B offered the Science, Mathematics and Technology Modules. The Education Module was presented by the Education lecturer appointed by the University in City A. The FDE presented in City A differed in that the Technology Module was presented by the NGO in City A while the University offered the Science, Mathematics and Education Modules.

Secondly, since the NGO branch manager in City B presented three of the four Modules in the FDE, the students attended lectures almost entirely at the NGO branch in City B, and not at the University as was the case for the FDE offered in City A.

Thirdly, while the FDE course material was developed for the FDE presented in City A, the NGO branch manager in City B developed his own course material for the Technology Module and later also developed course material for the Science and Mathematics Modules. The lecturer who presented the Education Module opted to co-construct her curriculum with the FDE students and developed her own course material accordingly.

Fourthly, while the FDE in City A was presented in Modular form in two-week blocks during the educators' vacation over a two-year period, the FDE in City B was offered for two days at the end of each month and over a five-day period during the educators' vacations over a two-year period of part-time study.

Lastly, the University in City A administered both the FDE programmes presented in City A and City B. To facilitate this process the lecturer who was appointed to present the Education Module at the University campus in City B was also appointed to co-ordinate the FDE programmes on both campuses. In 2000, when the Education lecturer/FDE co-ordinator went on leave, another Education lecturer was employed to offer the Education Module whilst another individual was employed as the FDE co-ordinator (Interviews NGO Executive Director 6 September 1999 and NGO branch manager 10 June 2000).

The background to the conceptualisation of the FDE has been sketched in this chapter. The findings of the implementation of the FDE in City B, which is the focus of this research, will be presented in Chapters 7, 8, 9 and 10. The methodological framework for this research will be presented in the next chapter.

Chapter 4 The Methodological Framework

This research was conducted within the interpretive paradigm. In this chapter salient features of this paradigm are presented in support of this position. Research methods and other aspects like trustworthiness, consistency, generalisability, and ethical considerations pertaining to this research are also described.

4.1 The interpretive paradigm

There are different research 'paradigms' or 'traditions' distinguished from one another by contrasting ontological and epistemological assumptions. In this research the term 'paradigm' is used interchangeably with the term 'tradition'. This research adopts Guba's (1990:7) definition of the term 'paradigm' to mean "a basic set of beliefs that guide action, whether of the everyday ... variety or action taken in connection with a disciplined inquiry". Atkinson *et al*, as cited in Lather (1991:11), caution that paradigms "must be treated not as clearly defined, real entities but only as loose frameworks for dividing research".

The interpretive paradigm, also called the hermeneutic tradition, developed as a reaction against the positivist research paradigm. There was a shift from the *"found"* to the *"constructed"* worlds (Lather 1991:9). Kuhn (1970:157-8) argues that "a paradigm shift comes about not from a single group conversion but rather from an increasing shift in the distributions of professional allegiances as practitioners of the new paradigm explore its possibilities and demonstrate what it would be like to belong to the community guided by it". The positivist paradigm has been criticised for its technicist element that seeks to control and predict relationships within and between variables and its view that knowledge is absolute. Researchers working within this paradigm have also been criticised for their singular view of reality that is measurable through 'objective' and 'value-free' scientific or quantitative methods.

Researchers within the interpretive paradigm argue that human action is value laden and "cannot be understood independent from human interests and activities" (Packer and Addison 1989:19). Researchers thus focus on how people interact and negotiate within social situations, which are not only defined by the individuals in the social situation, but the individuals are themselves also defined by the situation. In other words "people both constitute and are constituted by their social context" (Packer and Addison 1989:19).

The purpose of interpretive research is to understand ("verstehen") as opposed to explain human actions and phenomena (Janse van Rensburg 1994:7), and "interpret meaning within the social and cultural context of the natural setting" (Cantrell 1993:84). Within this paradigm there are multiple perspectives of the world, and reality is constructed by individual experiences and understanding which are "shaped by the interactions in the inquiry" and require multiple methods for understanding (Janse van Rensburg 1994:6).

Phenomena and human interactions are understood through the mental process of interpretation (or thinking about it) that is "influenced by and interacts with [the] social context" (Cantrell 1993:83). The meaning of interpretation as "the development of a plausible but contingent line of meaning attribution to account for a phenomenon ... even as one is accounting for a phenomenon one is aware that arguments for other accounts could also be given" (Giorgi 1992:122) is a valid one. The process of understanding and constructing meaning from human action is known as the circle of interpretation or "the *hermeneutic circle*" which is explained by Packer and Addison as follows:

> When we try to study some new phenomenon we are always thrown forward into it. Unless it is totally alien we will have some preliminary understanding of what kind of phenomenon it is, and of what possible things might happen to it. This means that we both understand it and at the same time misunderstand it ... The circularity of understanding, then, is that we understand in terms of what we already know. But the circularity is not, Heidegger argues, a "vicious" one where we simply confirm our prejudices, it is an "essential" one without which there would be no understanding at all. And the circle is complete; there is accommodation as well as assimilation. If we are persevering and open, our attention will be drawn to the projective character of our understanding and – in the backward arc, the movement of return – we gain an increased appreciation of what the fore-structure involves, and where it might best be changed.
>
> Packer and Addison (1989:34)

A shortcoming of the interpretive paradigm from a critical perspective is its failure to transform the social reality of participants and its "silent support for the status quo" (Janse van Rensburg 1994:7). The critical paradigm seeks to emancipate participants by changing their understanding of their context through critical reflection leading to change and improved social conditions. In the critical paradigm reality is constructed and divergent, and knowledge is viewed "within [a] social and economic context with the emphasis on ideological critique and praxis" (Cantrell 1993:83).

Other charges made against the interpretive paradigm centre around four issues, according to Schwandt (1994:130-131). Firstly, the relative nature of researchers' accounts is said to be problematic because there are no set criteria against which to judge subjectively constructed interpretations and meanings, and all accounts could be considered equally good or bad. Secondly, the inability of researchers within this paradigm to critique their own accounts since the researchers are not able to distance themselves from the people and the social contexts within which they conduct their research. Thirdly, the possibility that the 'authoritative stance' of researchers could silence participants' 'voices' while constructing and interpreting meaning to their actions. Lastly, the tension between researchers' claims that 'knowledge' is constructed in the individual's mind and 'knowledge' that can be publicly shared. The above concerns are addressed in Chapter 6 when the research process is discussed.

This research is located within the interpretive paradigm to describe and understand how emerging educational Policy in INSET (a contemporary phenomenon) was implemented in the FDE at the Higher Education level and practised by selected participating Senior Phase educators in their schools (real-life contexts). The focus was thus on understanding and interpreting the activities and "complex inter-relations" of and between the different stakeholders in their particular contexts (Cantrell 1993:101). To achieve this aim it was necessary to understand the 'parts' of the 'whole' that in turn depended on an interpretation of the 'parts', since knowledge formation is conceived as "circular, interactive, spiral" and not "linear and cumulative" as suggested in the positivist paradigm (Usher 1996:18).

As the researcher within the interpretive paradigm I was able to "interact dialogically with the participants" (Cantrell 1993:84) and constructed meaning from the participants' activities within the FDE and the schools, and interpreted what meanings role-players in the FDE and participating educators attached to their particular contexts. Interpretivists concede that impartiality is not possible since "interpretations are temporal, located, and therefore open to reinterpretation" (Angen 2000:386). Since the epistemological position in this research is essentially subjective and not 'value-free', the interpretations are presented through narrative accounts and "thick descriptions" (Geertz 1993:10). In other words, the author aims to provide descriptions to allow multiple meanings of behaviour to be interpreted and understood.

It is accepted that the research tradition guides the methods researchers use and that decisions need to be made according to "the purpose of the inquiry, the questions being investigated and the resources available" (Patton, as cited in Cantrell 1993:93). Since there are multiple realities within an interpretive paradigm, researchers working within this paradigm need to make use of multiple methods to construct these realities. Accordingly, a description of the research design and methods employed in this research follows.

4.2 The research design

A research design is a plan that guides the researcher in the process of collecting, analysing and interpreting data. As Yin states, "the design is the logical sequence that connects the empirical data to a study's initial research questions and, ultimately, to its conclusions" (Yin 1984:28). Yin refers to a case study as a "research strategy" that is used "when the focus is on a contemporary phenomenon within some real-life context" (p.13). Since this research sets out to understand a 'contemporary phenomena' in a 'real life' context, a case study research design was appropriate.

Robson (1993:53) argues that a case study is a strategy, not a method. The strategy is concerned with research in a broad sense and relies on the collection of evidence about what is going on in a particular context using multiple methods of evidence or data collection.

An embedded case study is similar to a single or individual case study except that it involves "more than one unit of analysis" (Yin 1984:49). In this research the embedded cases are the FDE and the school context. Within these embedded cases individual cases or units were investigated. The FDE has four Modules that constituted the individual cases namely, Technology, Science, Mathematics and Education. Two Technology lessons presented at two urban schools composed the individual units in the embedded school context. In this research no distinction is made between conducting single and multiple case research since Yin argues "the choice is considered one of research design, with both being included under the case study strategy" (Yin 1984:52).

A possible pitfall of using a multiple case approach is for the researcher to focus only on the smaller units of analysis and not to return to the larger unit of analysis. Some researchers also view case studies with skepticism because of the perceived lack of rigour and little basis for generalisation (Yin 1984:21). How these concerns were addressed in this research will be discussed in Chapter 6. First the research methods employed in this research will be discussed.

4.3 The research methods

As stated earlier, there are multiple realities within an interpretive paradigm and researchers working within this paradigm need to make use of multiple methods to construct these realities. Multiple sources of evidence are in line with case study strategies and allow researchers to 'triangulate' data from different data sources in order to verify the accuracy of their accounts or to "find divergence among sources of information" (Creswell 1994:158). The research methods engaged in this research, namely participant observation, interviews, the analysis of documents and artifacts will now be discussed in turn.

4.3.1 Participant observation

In the interpretive paradigm the researcher does not control the data collection environment as in the positivist paradigm, hence there is a need to integrate data collection into the real-life contexts namely, the FDE and the selected schools. To achieve the aims of this research, prolonged fieldwork was conducted that entailed extensive observations for the duration of the FDE over a two-year period. An additional three days was spent at each of the two schools during the latter part of this two-year period. The role of participant observer adopted by Robson (1993:159) where the researcher takes on a role other than that of passive observer and actively participates in the events being studied, was assumed during the fieldwork.

There are a number of advantages to being a participant observer. Firstly, investigators who are known to the participants also enjoy the advantage of "being able to move about, observe or question in a relatively unrestricted way", according to Lofland and Lofland (1995:73). Secondly, researchers can record information as it occurs and can note unusual events during observation. Thirdly, the researcher can interact on a 'first hand basis' with participants (Creswell 1994:150).

These advantages need to be carefully considered against the possible disadvantages of participant observation. One disadvantage that Yin cautions against is the "potential biases" on the part of the researcher (Yin 1984:93). In interpretive research the researcher is the 'primary instrument' for data collection and analysis and therefore, offers interpretations that are essentially 'positioned'. The researcher thus needs to be explicit about the 'position' adopted and the values and judgments made while conducting research and analysing the data. Other disadvantages that may arise in participant observation include the possibility of the researcher being intrusive; confidential information not being reported on, and the researcher lacking good observation skills (Creswell 1994:150).

Rossman and Rallis (1998:38) warn that, "the personal biography of the researcher and the role she takes influence the research – both the sense she makes of the setting and how people she studies make sense of her". These authors refer to the phenomenon where the researcher reflects on her relationship with those being researched as 'reflexivity' which means "capable of turning or bending back" (Brown, as cited in Rossman and Rallis 1998:38). 'Reflexivity' captures both the reactions that naturally occur when an outsider enters a setting and the capacity to reflect on those reactions.

In addition to participant observation, evidence was gathered through interviews with participants, through the textual analysis of documents and artifacts.

4.3.2 Interviews

Interview data is appropriate in interpretive research because "hermeneutics is the study of the interpretation of texts" and the interview is "the oral discourse transformed into texts to be interpreted" (Kvale 1996:46). In the naturalistic tradition, "the prime sources of data are the *words* and *actions* of the people you are interviewing and observing ... you 'get at' your prime sources of data – words and actions – through a combination of *looking, listening and asking"*, according to Lofland and Lofland (1995:71). Interview data is an appropriate inter-subjective way for participants and researchers to exchange meanings and interpretations of particular events or actions. Audio-tape recordings also extend the range and precision of the observations that can be made.

Patton (1990:206) identifies four different types of interviews. The first type is the "informal conversational" interview that is suitable for gaining information from the "immediate context" by asking questions in the "natural course of things" (Hughes 1996:170). The second type is referred to as the "interview guide approach" where the topics and issues to be discussed are specified in advance and the researcher decides the sequence and wording of the questions during the course of the interview. In the third type, the "standardised open-ended interviews", respondents are asked the same basic questions with the exact wording and sequence determined in advance. Lastly, the fourth type is the "closed quantitative interviews" where the respondents are asked predetermined questions and choose their answers from predetermined fixed responses.

Kvale (1996:109) argues that "personal interaction in the interview affects the interviewee, and the knowledge produced by the interview affects the understanding of the knowledge produced". This author cautions that transcribed interview texts are incomplete accounts of the meanings expressed in the lived interview situation and argues:

> The researcher is critical to the quality of the scientific knowledge and for the soundness of ethical decisions in any research project. By interviewing, the importance of the researcher as a person is magnified because ...[she] is the instrument for obtaining knowledge ... in the end, however, the integrity of the researcher – his or her honesty and fairness, knowledge and experience – are the decisive factors.
>
> Kvale (1996:117)

How the above challenges were addressed in this research will be discussed in Chapter 6.

4.3.3 Documents

Documents are generally written texts and are appropriate as a data source in interpretive research since "hermeneutics focuses on the interpretation of texts" (Kvale 1996:46). A basic distinction may be made between primary sources and secondary sources of documents, the former being "materials that are gathered first hand and have a direct relationship with the people, situations or events that are studied" like minutes, contracts, letters, memoranda and reports (Burgess 1984:123). This author also distinguishes between documents that are "public" and "private" and may be "solicited" or "unsolicited". The "unsolicited" documents are those produced without research in mind while the "solicited" documents are produced at the request of the researcher (p.124).

The use of documents is an important source of information for a researcher. Many organisations and settings "have ways of representing themselves collectively to themselves and to others" through written records and other kinds of documents (Atkinson and Coffey 1997:45). A variety of unsolicited documents was used in this research (details appear in Table 6 in Chapter 6) to "corroborate and augment evidence from other sources" and to gain an understanding of the events and settings investigated in this research (Yin 1984:86).

Documents do not usually need to be transcribed therefore saving time during the data collection phase. Yin (1984:86) warns however, "documents should not be accepted as literal recordings of events that have taken place" and researchers need to ensure that the documents are authentic. In addition, documents do not "stand alone" but are inextricably linked to other documents and "other realities and domains" and need to be situated within a particular context for their content to be understood (Atkinson and Coffey 1997:55). A possible disadvantage of using documents is that the documents may not be accessible to the researcher and the researcher may also be required to 'seek them out'.

In addition to documents, a number of different artifacts were scrutinised during the course of this research.

4.3.4 Artifacts

Artifacts may be "physical or cultural" and may include "a technological device, a tool or instrument, a work of art, or some other physical evidence. Such artifacts may be collected or observed as part of a field visit" (Yin 1984:94). Artifacts were useful in this research since they gave a broader perspective to what the participating students and learners experienced in the FDE and the school context respectively. Details of the artifacts scrutinised in this research are given in Chapter 6. In addition, the artifacts verified information gained from other data sources.

4.4 Verification

Designing and carrying out 'valid' research is the desired goal of all researchers. Verification and ethical issues, however, do not belong in separate stages of an investigation but should be addressed throughout the entire research process. How one demonstrates the validity or trustworthiness of one's research depends on the research paradigm within which the research is conducted. Within the positivist paradigm, the researcher seeks to uncover the 'truth' and relies on rigorous and objective methodological rules and standards to ensure the validity of the research, whereas within the interpretive paradigm the researcher strives to "find a way to claim legitimacy and trustworthiness without the necessity of laying claim to uncontested certainty" (Angen 2000:379).

The criteria for assessing 'legitimacy' in the interpretive paradigm must necessarily be different from that of assessing 'validity' in the positivist paradigm (Lincoln and Guba 1985:219). The interpretive paradigm requires a more appropriate reformulation of validity and Smith (1984:390) suggests it is time we "dispense with the traditionalist ideas of objectivity and truth and realise that we are 'beyond method'". Criteria for trustworthiness like credibility, dependability and confirmability, instead of the positivists' internal validity, reliability and objectivity, is suggested by Lincoln and Guba (1985:219). This research refers to 'validity' as 'trustworthiness', 'consistency' instead of 'reliability' and relies on 'thick descriptions' to facilitate 'applicability' instead of 'generalisability'. Each of these concepts will be discussed in turn.

4.4.1 Trustworthiness

In qualitative research "ideas about what precisely constitutes good research have become blurry" according to Rossman and Rallis (1998:44). These authors suggest that qualitative researchers ask "does the study conform to *standards for acceptable and competent practice* ... [and] has it been *ethically conducted?*" (p.43). These questions are interrelated since research can meet acceptable standards, but if it is not conducted ethically, then it falls short on integrity. These authors maintain that the research must have credibility with readers who must believe and trust its integrity.

Robson (1993:160) argues that trustworthiness "relies on the *human* instrument (the researcher) rather than the data collection techniques *per se*". He lists the following personal qualities that researchers should have in order to conduct case study research successfully: "an open and inquiring mind; being a good listener; adaptiveness and flexibility". Consistency will also be assured if the researcher has "some familiarity with the phenomenon and the setting under study, conceptual skills, including doggedness and the ability to draw people out" (Miles and Huberman 1984:46).

4.4.2 Consistency

The notion of consistency in interpretive research, where the social world is always changing, is in direct contrast to the unchanging social world in positivist research. Merriam, as cited in Rossman and Rallis (1998:46) states "because what is being studied [in qualitative research] is assumed to be in flux, multifaceted, and highly contextual ... achieving reliability in the traditional sense is not only fanciful but impossible". Thus "the concept of replication is itself problematic", according to Marshall and Rossman (1989:147). Understanding that reliability pertains to the "consistency of research findings" is valid for this research (Kvale 1996:235).

Silverman (1993:146-147) suggests that consistency can be addressed in qualitative research in the following ways:

- Reliability and Observation – extended extracts of field notes would be helpful, and the reader also should require information on how field notes were recorded and in what contexts.
- Reliability and Texts – the data are already available and issues of reliability now arise only through the *categories* one uses to analyse each text. It is important that these categories are used in a *standardised* way, so that any researcher would categorise in the same way.
- Reliability and interviews – it is important each respondent understands the questions in the same way and that answers can be coded without the possibility of uncertainty.

The issue of consistency pertaining to this research will be discussed in Chapter 6 while the subject of applicability is now presented.

4.4.3 Applicability

Rossman and Rallis (1998:47) refer to "applicability to other situations" as paralleling the postitivist reference to 'generalisability'. Since the aim of interpretive research is not to generalise or enumerate frequency, but rather to create an in-depth understanding of a particular context, these authors advise researchers to provide "rich, thick descriptions of your theoretical and methodological orientations" Rossman and Rallis (1998:47). These authors also urge researchers to provide as much detail of the context, the process as well as the results as is feasible, so that "potential users can then determine for themselves if your results will be of use in a new but similar setting". Information about the context and processes in this research will be provided in Chapter 6 so that the reader can make judgments concerning the applicability of this research to other contexts. The ethical issues in this research will now be discussed.

4.5 Research ethics

Hermeneutic or interpretive researchers are confronted by a series of "methodological dilemmas" that "involve researchers in making decisions about how they should conduct themselves, and are therefore concerned with the rights and responsibilities of both researcher and researched", according to Scott (1996:68). Ethical issues arise throughout the entire research process and not only at the data collection stage.

Lofland and Lofland (1995:75) suggest that "the question of providing confidentiality to the people studied does not usually arise until the write up stage" and caution that researchers "should understand confidentiality practices in data logging as strategies not only for protecting the people they study but also for protecting themselves".

Confidentiality implies that private information identifying the participants will not be reported. Participants need to agree to the release of the information if they may be recognised by others. It is the researcher's responsibility "to reflect on the possible consequences not only for the persons taking part in the study, but for the larger group they represent, as well" according to Kvale (1996:116).

One way to minimise potential problems is to obtain the written consent of all the participants. "Informed consent involves informing the participants about the overall purpose of the investigation and the main features of the design, as well as the risks and benefits from participation" (Kvale 1996:112). How ethical issues were dealt with in this research will be discussed in Chapter 6.

This chapter has served to sketch the interpretive research paradigm and the reasons for adopting this paradigm for this research. Research methods and aspects like trustworthiness, consistency, applicability and ethics pertaining to this research were also discussed. The conceptual framework applicable to this research will be discussed in the following chapter.

Chapter 5 The Conceptual Framework

In this chapter Activity Theory, as the conceptual framework for this research, is described. A brief discussion of the philosophical underpinning and the development of Activity Theory is given, followed by the relevance of Activity Theory to this research.

5.1 Activity Theory

Activity Theory is not a 'theory' in the strict sense of the word and different authors refer to it in different ways. Preece, Rogers, Sharp, Benyon, Holland and Carey (1994:194) suggest that Activity Theory is "an evolving theoretical framework which is used to inform the analysis and implementation of systems that are used in the workplace". Activity Theory is described as a "set of basic principles that constitute a general conceptual system, rather than a highly predictive theory" by Kaptelinin and Nardi (1997:unpaged).

In this research Activity Theory is referred to as a conceptual framework that guided the interpretation and analysis of the implementation of emerging INSET educational policy in the FDE and by participating educators in their schools. A conceptual framework allows the researcher to decide what the important features in a study are, which relationships are likely to be important, what data is to be collected and how it will be analysed, according to Robson (1993:38).

Activity Theory originated in Russia in the 1920s and 1930s. It is a cultural-historical theory of activity based on the ideas of Hegel and Kant and the theory of 'dialectical materialism' developed by Marx and Engel (Wertsch 1979:9). Activity Theory developed from the works by Vygotsky, Luria and Leont'ev at a time when psychology was dominated by psychoanalysis and behaviourism.

Several psychological theories have focused on human 'action' where the individual interacts instinctively with the environment. These theories fail to take into consideration the materialist theoretical understanding of the individual. Understanding the individual in terms of the internal psychological process then becomes problematic since these theories fail to consider the social origins of behaviour and seek to explain internal psychological processes independently of the context in which they are produced.

The historical-cultural school seeks to focus on a unit of analysis that captures the individual in context. 'Activity' is such a unit. The individual engages in actions in particular contexts. These actions involve the use of 'tools' that may be physical artifacts or psychological tools such as signs, symbols and discourses that play a mediating role between the individual and the context in the process of the 'activity'. For example, in a South African school classroom the educator may use OBE as a conceptual tool to mediate her own actions and the actions of her learners in the 'activity' of teaching and learning.

In Activity Theory the unit of analysis is an 'activity' based on the assumption that the human mind exists and develops within a context where humans interact with their environment in a meaningful, goal-orientated and socially determined manner. An activity "is driven by various needs, in which people want to achieve a certain purpose (or goal)" and cannot be analysed outside of the context in which it occurs (Preece *et al* 1994:194).

Three theoretical generations in the evolution of Activity Theory are discernable according to The Centre for Activity Theory and Developmental Work Research (1998a:unpaged).

5.1.1 The first generation of Activity Theory

The first generation of Activity Theory developed from Vygotsky's concept of "artifact-mediated and object-orientated action" (Vygotsky 1978:40). This theorist created the idea of 'mediation' where an individual interacts with her environment through the use of material or mental 'tools'. Vygotsky's view of human action is represented in Figure 1 and has a tripartite structure: a 'subject', an 'object' and 'mediating tools'.

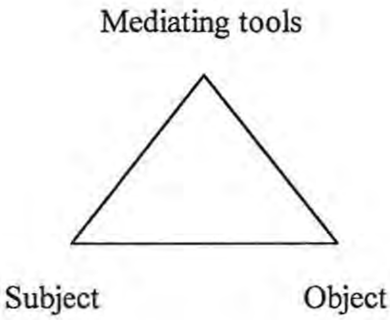


Figure 1. Human action as a tripartite structure (Vygotsky 1978:40)

The 'subject' is an individual or group of individuals engaged in the action. The 'object or 'objective' of the action is determined by the 'subject' and may be a physical or a conceptual product. The 'mediation' occurs when the individual uses different 'tools' to reach the 'object' of the activity. Mediation is an *active process* since the use of the 'tools' not only becomes a means of mediating the action in order to achieve the 'object', they also influence the nature and mental functioning of the 'subject'. The 'tools' in turn are also created and transformed during the action and reflect a cultural-historical aspect of social knowledge. As Vygotsky states:

> ... by being included in the process of behaviour, the psychological tool alters the entire flow and structure of the mental functions. It does this by determining the structure of a new instructional act, just as a technical tool alters the process of a natural adaptation by determining the form of labour operations.
>
> Vygotsky (1981:137)

Mediation also involves both constraint and empowerment since mediated action provides opportunities for introducing new 'tools' that may overcome existing problems while these 'tools' may also bring with them new limitations, according to Wertsch, del Rio and Alvarez (1995:24). These authors argue that while we are often able to recognise these constraints, in retrospect we are not always "able to free ourselves of the constraints imposed by the cultural tools we use to act" (*ibid*). Furthermore, these authors claim:

> … cultural tools usually emerge for reasons other than to facilitate the kinds of action they in fact end up shaping … the implicit assumption is often made that cultural tools such as language somehow emerged in the service of the forms of mental functioning they mediate. However, this is seldom the normal course of events. Instead, mediational means often emerge in response to a host of forces typically unrelated to the form of mental functioning at issue. Then these means are incorporated into action in unanticipated ways. The implication of such a claim, of course, is that human action, including mental functioning, is shaped by forces that have little to do with an ideal design.
>
> Wertsch *et al* (1995:25-26)

These authors argue that these "accidental and unanticipated effects" or "spin-offs" may take two forms: (1) the use of cultural tools for purposes other than the one that shaped its evolution, and (2) the use of tools developed for a particular context that are borrowed to be used in quite a different context (Wertsch *et al* 1995:27-28).

Since Vygotsky's work was object-orientated action mediated by cultural 'tools', it did not take into account the part played by the social interaction of other human beings. The second generation of Activity Theory addresses this shortcoming "by distinguishing between collective activity and individual action" (The Centre for Activity Theory and Developmental Work Research 1998a:unpaged).

5.1.2 The second generation of Activity Theory

The second generation of Activity Theory developed by distinguishing between 'activity', 'action' and 'operation' as the basis of Leont'ev's (1981:210) three-level model of activity. These levels are illustrated in Figure 2 below:

Level		**Orientated towards**	**Carried out by**
Activity	----->	motives	Community
Action	----->	goal	Individual or group
Operation	----->	conditions	Human or machine

Figure 2. **Three level model of activity** (adapted from Centre for Activity Theory and Developmental Work Research 1998b:unpaged)

In Leont'ev's model at the upper level the object-related motive of the 'subject' (an individual or a group engaged in the activity) drives the collective activity. The 'object' is similar to that of an 'object of a game' and "each motive is an object, material or ideal, that satisfies a need" according to Kaptelinin (1996:108). 'Objects' may be transformed during the activity and in turn may also fundamentally change the nature of the 'activity' (Nardi 1996:74). In addition, different 'subjects' may be engaged in the same 'activity' with multiple or conflicting 'objects' in mind (Kuutti, as cited in Nardi 1996:74). For example, an educator may arrange a visit to a museum that she hopes the learners in her History class will find interesting. The learners in the class however consider the visit an opportunity not to do any schoolwork and spend the time at the museum playing hide and seek.

At the middle level, below the level of collective activity, is individual or group action that is driven by a conscious goal to fulfil the 'object'. Different actions or tasks may be employed to achieve the same goal. Leont'ev gives the following example:

> A person may have the object of obtaining food, but to do so he has to carry out actions not immediately directed at obtaining food ... His goal may be to make a hunting weapon. Does he subsequently use the weapon he made, or does he pass it on to someone else and receive a portion of the total catch? In both cases, that which energizes his activity and that to which his action is directed do not coincide.
>
> Leont'ev (1974:6)

. At the lowest level is individual action that involves automatic operations that are dependent on the 'tools' at hand and the conditions in which the action is performed (Engeström and Miettinin 1999:4).

Leont'ev draws attention to the "transformation going on between the levels" (Engeström 1999:23) and gives the following example of learning to drive a car to illustrate this point.

> Initially every operation, such as shifting gears, is formed as an action subordinated specifically to this goal and has its own conscious 'orientation basis'. Subsequently this action is included in another action, ... for example, changing the speed of the car. Now shifting gears becomes one of the methods for attaining the goal, the operation that effects the changing in speed, and shifting gears now ceases to be accomplished as a specific goal-directed process: the goal is not isolated. For the consciousness of the driver, shifting gears in normal circumstances is as if it did not exist. He does something else: He moves the car from a place, climbs steep grades, drives the car fast, stops at a given place, etc. Actually this operation [of shifting gears] may, as is known, be removed entirely from the activity of the driver and be carried out automatically.
>
> Leont'ev (1978:66)

Engeström (1987:78) modified Leont'ev's version of 'activity' and presented a model of collective Activity Systems in the third generation of Activity Theory.

5.1.3 The third generation of Activity Theory

Engeström's model organises the 'elements' of any 'activity' into an Activity System (Engeström 1987:78). The Activity System represents "culturally situated and linguistically and technologically mediated" activities that are "enacted in communities and involve a division of labour" (Blackler, Crump and McDonald 2000:280). The Centre for Activity Theory and Developmental Work Research suggests that the model shows "the possibility of analysing a multitude of relations within the triangular structure of activity. However, the essential task is always to grasp the systemic whole, not just separate connections" (Centre for Activity Theory and Developmental Work Research 1998b:unpaged). The Centre for Activity Theory and Developmental Work Research (1998b:unpaged) defines the 'elements' in Engeström's Activity System as follows:

- The '*subject*' refers to the individual or sub-group whose agency is chosen as the point of view in the analysis.
- The '*object*' refers to the 'raw material' or 'problem space' at which the activity is directed and which is molded and transformed into *outcomes* with the help of physical and symbolic, external and internal mediating instruments, including both tools and signs.
- The '*community*' comprises multiple individuals and/or sub-groups who share the same general object and who construct themselves from other communities.
- The '*division of labour*' refers to both the horizontal divisions of tasks between the members of the community and the vertical division of power and status.
- The '*rules*' refer to the explicit and implicit regulations, norms and conventions that constrain actions and interactions within the activity system.

The relationships between the 'elements' in an Activity System are illustrated in Figure 3.

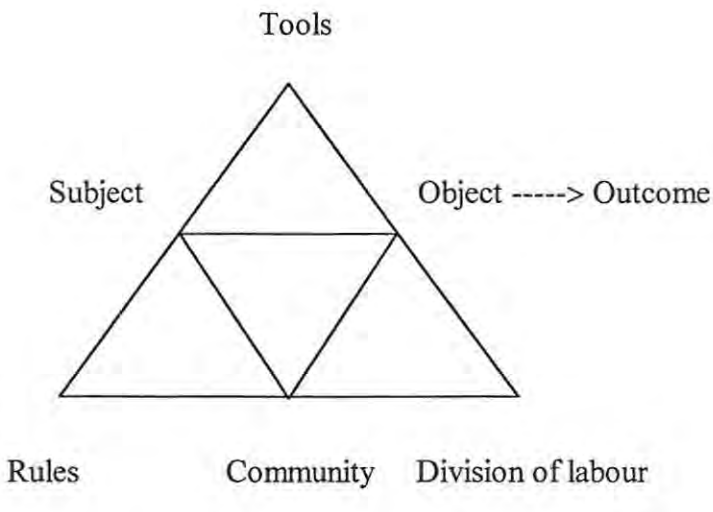


Figure 3. Engeström's Activity System Model (Engeström 1987:78)

Activities in Engeström's model consist of "goal-directed hierarchy of actions ... [that] are chains of operations" (Jonassen and Rohrer-Murphy 1999:63). There is a dynamic relationship between activities, actions and operations. Leont'ev describes it thus:

> In this respect activity represents a process that is characterized by continuously proceeding transformations. Activity may lose the motive that elicited it, whereupon it is converted into an action realizing perhaps an entirely different relation to the world, a different activity; conversely, an action may turn into an independent stimulating force and may become a separate activity; finally, an action may be transformed into a means of achieving a goal, into an operation capable of realizing various actions.
>
> Leont'ev (1978:67)

This relationship between the interactive nature of activity, actions and operations may be represented in Figure 4 as follows:

Activity	-	Motive
↕		↕
Action	-	Goal
↕		↕
Operation	-	Conditions

Figure 4. The hierarchical and interactive nature of activities, actions and operations (Jonassen and Rohrer-Murphy 1999:63)

Engeström makes the following assumptions in his Activity System model of Activity Theory according to Jonassen and Rohrer-Murphy (1999:64-68):

1. Activity and consciousness co-exist and are inter-related. "As we act, we gain knowledge which affects our actions which changes our knowledge" (p.64).
2. Consciousness is not a discrete act, rather it is manifest in practice. "What we do is embedded in a social matrix, composed of people and artifacts (physical tools and sign systems) that are used in the activity" (p.65).

3. Activity focuses on "incomplete and tentative" object-directed actions where the object is transformed during the activity and in turn affects the nature of the activity (p.65).
4. Activity develops over time and is "socially and contextually bound" and therefore needs to be understood in relation to the social practice of a particular community (p.66).
5. When activity is performed by individuals "their performance is predicated on groups of people" (p.67).

An example of an educator in a South African school may be useful at this point. The 'object' for the educator is the education of the learners sitting for their final matriculation examination. The 'outcome' may be for all the learners to pass the matriculation examination with exemption. The 'tools' at the educator's disposal to achieve the 'object' may include equipment 'tools' like chalk and a chalkboard, study notes, a scientific calculator and a textbook, and conceptual 'tools' like problem-solving in Mathematics. The 'community' may consist of amongst others, the learners' parents and the officials in the Department of Education who indirectly influence whether the 'object' is achieved or not. The parents may not be able to afford to buy the scientific calculator that the educator requires the learner to use to achieve the 'object'. The Department of Education may or may not supply the textbook that the educator needs to teach mathematical problem-solving effectively. The 'division of labour' within the school and classroom determines the decision-making powers of the educator and the learners and how they achieve the 'object'. Finally, the 'rules' operating within the classroom and the regulations pertaining to the matriculation syllabus and examination determine *inter alia* how the educator and the learners use the 'tools' at their disposal to achieve the 'object', how the success of the outcome is measured, and the criteria for possible rewards like bursaries for achieving the outcome.

The description thus far of an Activity System highlights the 'elements' or 'components' of the Activity System rather than its *transformative ability* and suggests a 'snap shot' approach that lists what 'elements' exist at a particular point in time. An Activity System is, by its nature, in a process of constant change and transformation and is not static. There is constant construction and renegotiation within the 'elements' and Activity Theory allows for an understanding of change across time and place. As new 'subjects' enter the Activity System, tasks are reassigned and re-divided, 'rules' are reinterpreted. As new 'tools' (concepts, ideas or materials) become available, so the 'activity' will change. As the Activity System changes in the new context, so too, the 'elements' change. It is this dynamic process of change that the third generation of Activity Theory attempts to capture.

Central to the understanding of change is the idea of 'contradiction'. There are constant 'contradictions' within and between the 'elements' of an Activity System providing the opportunity for change and development and leading to "continuous transitions and transformations between [the] components of an activity system" according to Engeström and Miettinen (1999:9).

Four levels of 'contradictions' may be found in an Activity System, according to the Centre for Activity Theory and Developmental Work Research (1998b:unpaged). The four levels of 'contradictions' are:

- Primary 'contradictions' that arise when there is a contradiction *within the elements* in relation to the 'object' in the Activity System. For example, a learner is required to use a pencil and ruler (tools) to draw a 30 cm straight line (object). The learner however does not have a pencil and ruler therefore is unable to draw the line resulting in a primary contradiction within the 'tool' element in relation to the 'object';
- Secondary 'contradictions' that appear when new 'elements' enter the Activity System and tension results *between the elements* in relation to the 'object' of the Activity System. For example, an educator expects her learners to arrive for her class promptly (rule) when the school bell rings (tool). The learners however come late for class since the bell is broken resulting in a secondary contradiction between the 'rule' element and the 'tool' element in relation to the 'object', which is to attend the educator's class.
- Tertiary 'contradictions' that appear when a 'culturally' more advanced 'object' is introduced into an existing Activity System leading to a

tension with the existing 'object' of the Activity System. For example, when an educator insists on her learners working individually, introduces group work into her classes (a culturally more advanced object), tertiary contradictions or tensions arise since neither the educator nor the learners are familiar with the group way of working;

- Quadternary 'contradictions' that emerge between an Activity System and a neighbouring Activity System. For example, quaternary contradictions arise when educators in the school context (School Activity System) must use a textbook that the Department of Education has prescribed (a neighbouring Activity System) which does not meet with their approval.

Contradictions may lead to solutions being found in the form of "invisible breakthroughs" according to Il'enkov (1982:83-84), who states that resolution may come about as follows:

> In reality it always happened that a phenomenon which later becomes universal originally emerges as an individual, particular, specific phenomenon, as an exception from the rule. It cannot actually emerge in any other way. Otherwise history would have a rather mysterious form.
>
> Thus, any new improvement of labour, every new mode of man's action in production before becoming generally accepted and recognised, first emerges as a certain deviation from previously accepted and codified norms. Having emerged as an *individual exception* from the rule in the labour of one or several men, the new form is then taken over by others, becoming in time a new *universal norm.* If the norm did not originally appear in this exact manner, it would never become a really universal form, but would exist merely in fantasy, in wishful thinking.
>
> Il'enkov (1982:83-84)

When an activity is 'disturbed' or 'contradictions' occur, one needs to focus on the 'contradictions' and search for their origins in systemic causes, according to Engeström (2000:305), since resolution may only come about when the system is changed. Not all 'contradictions' will be resolved, however, and in these instances, Engeström argues, concrete innovative actions may lead to "a cycle of expansive learning which may lead to a redefinition of the object of the activity" (Engeström 2000:308-309).

The relevance of Activity Theory as an appropriate conceptual framework for this research is briefly illuminated.

5.2 The relevance of Activity Theory to this research

Engeström's third generation of Activity Theory provides a useful conceptual framework for understanding how educational policy in INSET is implemented in the FDE and practiced in the school context for a number of reasons. From this point forward Activity Theory will refer to Engeström's third generation of Activity Theory.

Firstly, Activity Theory is an appropriate conceptual framework within an interpretive paradigm since it negates objective representations of facts 'out there' and assumes that "knowing and doing" are culturally situated and "intimately related to the mediating factors through which they are constructed" (Blackler *et al* 2000:280). Activity Theory, like the interpretive paradigm, acknowledges multiple perspectives of reality and this allows the scope within which to construct interpretations of how educational policy was implemented in the FDE and selected schools.

Secondly, Activity Theory assumes that human action takes place within a specific social and historical context that can only be understood when the researcher is in a "dialogical relationship with the local activity under investigation" (Engeström and Miettinen 1999:10). This thinking is in line with an interpretive paradigm and allows for participant observation to interpret how people interact and negotiate meaning in the real-life contexts of the FDE and selected schools.

Thirdly, Activity Theory provides "a theoretical account" of the elements ('subject', 'object', 'tools', 'rules', 'community' and 'division of labour') that constitute "*object-orientated, collective*, and *culturally mediated human activity*" (Engeström and Miettinen 1999:9). This "theoretical account" allows for a clear focus and the conceptual tools to determine the important elements and relationships in the process of human action during the data collection and analysis phases of this research.

Fourthly, Activity Theory assumes a dynamic relationship between consciousness and activity (Jonassen and Rohrer-Murphy 1999:65) that aids understanding and interpretation of the educational activities and "complex interactions and relationships" (Engeström and Miettinen 1999:9) between and within the elements in the FDE and selected schools and their related activity systems.

Lastly, Activity Theory allows for the identification of contradictions and tensions within and between the 'elements' in the FDE and selected schools and their related activity systems and to ascertain how these contradictions and tensions were either resolved or not resolved. In other words, an account that is one of "multivoicedness" that stems from "disturbances and concrete innovative actions" and may be referred to as "developmental knowledge" (Engeström 2000:308).

5.3 The challenges of Activity Theory

Activity Theory is a socio-cultural lens through which human activity systems may be analysed. Whilst it provides us with an alternative way of viewing human thinking and activity that is socially and contextually bound, it also poses challenges for researchers.

Firstly, when analysing human activity using an Activity Theory approach, one needs to examine the kinds of activities that people engage in, who is engaging in the activity, what their goals and intentions are, what products result from the activity, and the larger community in which the activity occurs. Increasingly, traditional institutions like universities and schools are undergoing considerable changes and boundaries between activity systems are becoming more temporary, fluid and overlapping (Blackler *et al* 2000:293). Not only are activities and activity systems becoming larger, communities through which activities are enacted are themselves changing. Defining the boundaries of the activity systems, identifying the 'elements' in the different activity systems, identifying the 'contradictions' and the point at which 'contradictions' are resolved, is a complex process. Documenting and analysing such complex circumstances poses a challenge for researchers. Activity Theory has yet to develop conceptual tools to capture and understand multiple perspectives and networks of interacting activity systems.

In addition, since a fundamental assumption of Activity Theory is the unity of consciousness and activity (Kaptelinen 1996:104), the complexity of socio-culturally situated mental functioning needs to be addressed. For example, does the researcher give an account of the socio-cultural context and then generate an analysis of the subjects' mental functioning or does the researcher start with the subjects' mental processes and in so doing understand the socio-cultural context?

A second challenge facing researchers using Activity Theory as a conceptual framework, is seeking to highlight the *transformative ability* of an activity system by allowing for an understanding of change across time and place. Central to the understanding of change is the idea of tensions or 'contradictions' and it is through seeking the origins of these 'contradictions' in systemic causes that the system is changed and resolution of 'contradictions' comes about, according to Engeström (2000:305). However, seeking the systemic causes of the 'contradictions' may not necessarily lead to transformation of an activity system. Activity Theory posits that conscious learning emerges from activity (performance) not as a precursor to it. In other words, as we act, we gain knowledge, which affects our actions which changes our knowledge, and so on. Activity Theory suggests, "through their actions, people reinterpret their environment, rebuild their activities and reconceive of themselves" (Blackler et al 2000:297). The degree to which an activity system is transformed will thus depend on the agency of the participants, which is assumed. Whilst Activity Theory offers a promising avenue for dealing with changing human practices, it does not consider conditions that may constrain the agency of participants leading to their inability to transform an activity system.

Thirdly, Activity Theory is recognised as a theoretical framework to inform the design and interpretation of multi-disciplinary research. Its use as a tool, however, for informing decisions about how to identify, code and interpret data regarding the elements of an activity has not been widely reported in the literature. In other words, Activity Theory is a descriptive tool that "does not offer ready-made techniques and procedures for research" (Jonassen and Rohrer-Murphey 1999:68). As such, Activity Theory offers a challenge for researchers since techniques and procedures have to be concretised according to the specific nature of the object under investigation. For example, Engeström's model of Activity Theory identifies six 'elements' namely, 'subject', 'object', 'tool', 'rule', 'community' and 'division of labour' in an activity system. Whilst the 'tool' element embraces material and conceptual tools it does not allow for the subjects' frustration, excitement, fear and anxiety to be identified and coded. Emotions are coded as conceptual tools whereas perhaps they need to form an additional 'element' in an activity system since they impact on how the subjects act in relation to the other elements in any given activity.

Lastly, Engeström's version of Activity Theory focuses on tensions or 'contradictions' within and between the 'elements', and between 'elements' and neighbouring activity systems. The difficulty lies in discussing the 'contradictions' that emerge from the data in a way that avoids repetition given that the 'elements' are inter-related and affect one another. This aspect posed a major problem in this study and was resolved through the use of themes that ran within and across the 'elements', when the research findings were discussed.

The philosophical underpinnings and development of Activity Theory, the reasons why it is an appropriate theoretical framework for this research and the challenges of Activity Theory have been described in this chapter. The research process and issues such as the selection of the cases, data collection and recording, data analysis, verification processes and the limitations of this research will follow in the next chapter.

Chapter 6 The Research Process

In this chapter the research design and the research methods employed in this study are illuminated.

6.1 The research design

As stated earlier, the aim of this research was to understand how emerging educational policy was implemented in the FDE and practiced by participating educators in selected schools. An eclectic case study consisting of a series of embedded and single cases was designed based on the research design discussion in Chapter 4 section 4.2.

A series of embedded and single cases was appropriate for this research since the researcher was able to include the single cases or 'units' in both the FDE and the school context for reasons of greater clarity and not for purposes of 'replication' or 'prediction'. In other words, the researcher was able to interpret and understand more fully the activities and actions of participants in a real-life context in their 'parts' in relation to the 'whole'.

The eclectic case study design embraced a single or 'holistic' case pertaining to INSET and two embedded cases: the FDE and the school context. Within each embedded case the focus was on single 'units' or cases. In the FDE the focus was on the lecture sessions presented in the four Modules namely, Technology, Science, Mathematics and Education. In the school context two schools were purposefully selected and the focus was on the Technology lessons presented by an educator in these schools. The research design may be represented diagrammatically as in Figure 5.

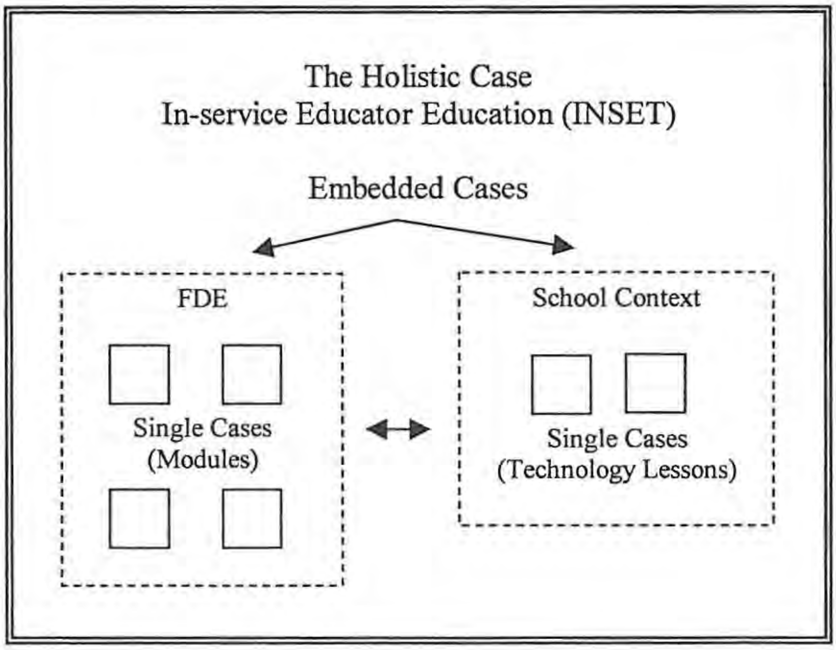


Figure 5. The research design illustrating embedded and single cases

The embedded cases namely, the FDE and the school context are now considered.

6.1.1 Embedded Case - The FDE

Since the focus of this research was on INSET in Technology the NGO branch in City B was approached for three reasons. Firstly, the NGO was recognised nationally for its contribution to INSET in Technology. Secondly, the NGO branch manager was an acquaintance through a colleague. Lastly, the NGO branch was easily accessible. After negotiating access, a letter was written to the NGO branch manager requesting permission for the research to be carried out at the branch in City B [see Appendix K for letter of request] and the NGO branch manager confirmed that the request had been granted.

In order to distinguish between the roles played by the participants in the FDE and the school context, the participants in the FDE will be referred to as follows:

- **NGO lecturer** – the NGO branch manager and presenter of the Technology, Science, Mathematics Modules in the FDE in 1999-2000;

- **Education lecturer/FDE co-ordinator** – the FDE co-ordinator and presenter of the Education Module in the FDE in 1999;
- **Education lecturer** - the presenter of the Education Module in the FDE in 2000;
- **FDE co-ordinator** - the FDE co-ordinator in 2000; and
- **Students** - the participating educators enrolled for the FDE in 1999-2000.

The second embedded case in this research was the school context.

6.1.2 Embedded Case – The school context

Two single cases were embedded within the school context. Four students were initially chosen - three males and one female – whilst selecting the two single cases to satisfy the need to select 'information rich' cases based on the location of the schools, the grade(s) and the learning area(s) taught. All four students taught a combination of Technology, Science and Mathematics to Grade 7 learners. These learning areas were chosen for three reasons. Firstly, Technology would be introduced into the school curriculum in the Senior Phase for Grade 7 for the first time in 2000. Secondly, Technology was linked to Science and Mathematics in educational policy documents. Thirdly, Technology, Science and Mathematics Modules had been presented in the FDE. Grade 7 was chosen since the students taught Mathematics and Science to Grade 7's in the Senior Phase and Technology would be introduced in the Senior Phase in 2000.

Two male students teaching at urban, 'township' schools were finally chosen since the other two students taught in rural schools where a lack of resources prevented the educators from offering Technology in their schools. 'Townships' or residential areas developed during the apartheid era when racially based laws forced black people to settle on the outskirts of towns and cities. The 'townships', unlike the 'suburbs' in the towns and cities where white people lived during the apartheid era, lacked a basic infrastructure and were poorly serviced. Unfortunately these conditions still persist in post-apartheid South Africa and in the Eastern Cape Province as was discussed in Chapter 3.

The two students chosen from the FDE and their schools in the school context will hereafter be referred to as follows:

- **Educator A at School A:** A male educator teaching Science and Technology to Grade 5, 6 and 7 learners in an urban township school.
- **Educator B at School B:** A male educator teaching Mathematics and Technology to Grade 5, 6 and 7 learners in an urban township school.

In addition, to distinguish between the roles played by the participants in the FDE and the school context, the other participants in the school context will be referred to as follows:

- **Principal** – the head educator in the school;
- **Educators** – all the other educators in the school;
- **Learners** – the learners in the classroom and/or attending the school; and
- **Governing Council members** – the learners' parents serving on the Governing Council at the school.

A letter was written to the Principal at School A and School B to request permission to visit their schools after the two students had confirmed that they would offer an invitation to the researcher to visit their schools [see Appendix L for letter requesting permission]. The students verbally confirmed that their Principals approved of the school visits and arrangements were made to contact the students telephonically early in 2001 to make further arrangements for the school visits.

6.2 Data Collection

Multiple methods of data collection were employed in line with interpretive and case study research namely, participant observation, interviews, documents and artifacts (previously discussed in Chapter 4 section 4.3.1, 4.3.2, 4.3.3 and 4.3.4 respectively).

6.2.1 Participant observation

The role of participant observer was chosen since personal contact with participants in the lecture sessions in the FDE and the lessons in the respective schools afforded the opportunity to: establish relationships with the participants, gain an insight into their real-life contexts, construct and revise meanings, and reflect on my interpretations whilst conducting my research.

A participant observer has to guard against being 'intrusive'. The goal was for the lecturers and students in the FDE and educators and learners in the schools to act naturally in the researcher's presence. The researcher tried to behave in such a way as to "minimize *reactive effects*" (Webb, Campbell, Schwartz and Sechrest 1996:270). This was difficult in the school context where many of the Principals, educators and learners had no experience of a white person visiting their school and/or observing their lessons. Not being able to converse in the participants' mother tongue, Xhosa, the researcher had to rely on the participants' goodwill to speak in English. In South Africa, mother tongue instruction takes place in the Foundation Phase (Grade 0 - Grade 2) whilst English is the language of instruction in the other Phases in the GET Band. Many learners however do not learn to speak English fluently since the educators are themselves not proficient in the language.

As the participants in the FDE and the schools became more familiar with the researcher's presence, she was able to move freely about to observe what they were doing. Questions were asked and discussions took place between the lecturers and students in the FDE, and educators and learners in the school context during the lecture sessions and lessons respectively when necessary.

There is a fine line between being an active participant and a passive observer playing the role of a participant observer. A conscious effort was made to be approachable and helpful, however, the researcher had to guard against being regarded as an 'expert' particularly when the lecturers and students asked for advice. The aim was to be present "as a naïve but interested outsider" to elicit data (Taylor and Bogdan 1984:45) since people are more willing to volunteer information when they perceive the recipient to be ignorant of the facts. As a result, constant reflection on the relationship with the participants took place whilst conducting fieldwork. It was difficult to anticipate the impact the researcher would have on the participants and their 'setting'. For instance, the researcher was drawn into curriculum restructuring and the development of an outcomes-based assessment rubric in the FDE. Neither did the researcher anticipate the profound impact that the participants and their 'setting' would have on her particularly when she visited the two schools and witnessed the appalling conditions that still exist in the schools in the Eastern Cape Province.

Being a participant observer and 'primary instrument' for data collection presented other challenges. One of the challenges concerned the eight-hour lecture sessions that were very taxing. Keeping focused for the duration of the lecture sessions required determination and self-discipline. Whenever possible field notes were typed up immediately after the lecture sessions ended. However, when the lecture sessions lasted for a series of four or five days this was not possible. The field notes were then typed up as soon as possible after the series of lecture sessions ended. Field notes should be written up as soon as possible after leaving the field since "the greater the time-lapse between the event and recording it, the more difficult it becomes to reconstruct problems and responses accurately and retain conscious awareness of one's original thinking" (Hopkins 1993:116).

Another challenge that was faced was to be constantly aware of the researcher's own values and judgments while conducting the research and analysing the data. Clarifying and reflecting on her position and the assumptions that she brought with her as a researcher and focusing on her research question was helpful in this respect.

To become data, observations have to be recorded in some way (Silverman 1993:116). During participant observation "substantive field notes" were kept in which "situations, events and conversations" were recorded (Burgess 1984:167). "Methodological field notes" were also made that consisted of personal reflections on the activities in the field (p.172).

On first entering the field, "broad descriptive categories" were used relating to people and activities (Silverman 1993:37). However, in time the focus was more on the 'elements' identified in Engeström's version of Activity Systems that provided the categories for the conceptual framework for this study (Engeström 1987:256). The researcher was conscious however not to focus exclusively on the 'elements' in the Activity System so as not to "deflect attention away from uncategorised activities" (Silverman 1993:42).

6.2.2 Interviews

Multiple methods of interviewing were chosen to obtain additional information to corroborate the evidence from other data sources. "Informal conversational" interviews (Patton 1990:206) were used to seek the participants' opinions on the lecture sessions or lessons and/or to seek their insights into issues concerning educational policy and how it is implemented in their particular context. The participants often suggested sources of corroboratory evidence that were then used as a basis for further inquiry (Yin 1984:89).

The "interview guide approach" (Patton 1990:206) that specified key topics without the order of questions being fixed formed the basis for the interviews with key role players and participants to establish facts as well as to ask for their insights into the conceptualisation and implementation of the FDE [see Appendix M for Interview guides].

The "open-ended interview" (Patton 1990:206) was used to obtain information from the NGO lecturer, Education lecturer/FDE co-ordinator and Education lecturer concerning what they intended to do during lecture sessions. 'Open-ended interviews' also provided feedback on attitudes and resources and insights into the lecturers' practice. Whilst not being able to conduct 'open-ended interviews' with the educators in their schools due to their full schedules, insight however, was gained into their teaching philosophies through the teaching portfolios they developed in the FDE. Most of the interviewees were not native English speakers and may have had difficulty understanding the researcher's questions. The researcher therefore asked probing questions to clarify the interviewees' understanding and to validate interpretations. Table 5 shows the types of interviews held with the different participants and role players in this study.

Table 5. The types of interviews with participants and role players

TYPE of INTERVIEW	INSTITUTION/ PROGRAMME	PARTICIPANT/ROLE PLAYER
Interview guide approach	The University in City A	Dean of Education Faculty Head of Education Department Senior Lecturer (Science) Education lecturer /FDE co-ordinator (1999)
	The University in City B	Director Administrative clerk
	NGO (Head Office)	Executive Manager
	NGO branch in City B	Branch manager/NGO lecturer
Open-ended interviews and informal conversational interviews	NGO branch in City B	NGO lecturer (1999-2000)
	The University in City B	Education Lecturer (2000) FDE co-ordinator (2000)
Informal conversational interviews	FDE	Students
	School A	Principal, Educators, Educator A and Learners
	School B	Principal, Educators, Educator B and Learners

Not all of the interviews were audio-taped, however, when the interviews were audio-taped the participant's permission was first obtained.

To address Kvale's (1996:50) concern that transcribing is problematic since it involves translating from an oral language with its own set of 'rules', to a written language with another set of 'rules', the audio-taped conversations were transcribed using transcription symbols. Instructions were given to the dictaphone typist regarding the procedure to follow when transcribing the audio-tapes that were not able to be transcribed by the researcher [see Appendix N for the transcription methodology]. The transcribed audio-tape recordings were printed and the hard copies filed along with the field notes and other information in topic and/or date order while the audio-tapes were stored in date order for easy retrieval.

6.2.3 Documents

Documentary evidence enabled the researcher to "corroborate and augment evidence" (Yin 1984:86) gained through participant observation and interviews with participants and other role players. Table 6 lists the documents that were examined. The documents have been grouped according to primary public, primary private, secondary public and secondary private documents (as elaborated on in Chapter 4 section 4.3.3). All the documents were unsolicited, meaning that they were not specifically drawn up for this research.

Table 6. The type, source and title of documents studied

TYPE	SOURCE	TITLE
Primary Public Documents	NGO	NGO *Education for Life* (undated); NGO *Kick-Start* (undated); NGO Annual Report (1997); and NGO FDE Unit Standards (1999).
	The University in City A	University Academic Year booklet (2000a); University Calendar (1999a, 2000b); University Draft and final timetables for the FDE Technology (1999b, 2000c); University Fee Structure (1999d, 2000d).
Primary Private Documents	NGO	NGO *A Teacher's Guide to the Technological Process* (1998).
	The University City A	University proposal to the Faculty of Education Board (no date); University memorandum of agreement between the University and the NGO (1996); University FDE syllabus (1998); Internal memoranda (1999-2000) from Registrar to HOD's regarding the format of examination papers, DP certificates and examination results.
	FDE Technology (1999-2000)	Minutes of FDE Facilitators' meetings (from April – December 2000); Minutes of FDE co-ordinator and students' meeting (June 2000); Lecture notes and schemes of work for the Technology Education, Science, Mathematics, Education Modules (July 1999 to November 2000); Letters to the FDE students from the FDE co-ordinator (1999-2000); Documents from the FDE Facilitators' OBE Workshop (May 2000); Documents from FDE Facilitators' Curriculum Development Workshop (June 2000); Personal e-mail communication between the researcher and the lecturers and FDE co-ordinator (1999-2000).
Secondary Public Documents	South Africa (Republic)	South African Qualifications Authority Act No. 58 (1995); No. 27 (1996); Government Gazette: No 17970 May (1997a); Government Gazette No 18221 August (1997b); Government Gazette No 18787 March (1998); Government Gazette No 20844 February (2000).

TYPE	SOURCE	TITLE
Secondary Public Documents	South African Department of Education	COTEP *Norms and Standards for Teacher Education.* February (1996); COTEP The Technical Committee On the Revision of Norms and Standards for Educators *Norms and Standards for Educators.* September (1998); DoE Discussion Document: *Lifelong Learning through a National Qualifications Framework* (1996); DoE Discussion Document. *An assessment policy for South Africa* (1997a); DoE *Curriculum 2005: Lifelong Learning for the 21st Century* (1997b); DoE Education White Paper 3: *A Programme for the Transformation of Higher Education.* July (1997c); DoE *Outcomes-based education in South Africa* (1997f); DoE *Phase Policy Document* (1997d,e,g); DoE Discussion Document: *Technology 2005: Draft National Framework for Developing Technology Education Curriculum* (1997h); DoE *A South African Curriculum for the Twenty First Century* (2000).
	Newspaper articles	Pretorius, C. (2000, 4 June). New education plan: How it works. *Sunday Times*, p.6. Potenza, E. (2001, 5 August) Looking forward to curriculum reform. *ReadRight, a supplement to the Sunday Times*, p.4.

In addition to documents, access was gained to a number of different artifacts during the course of the research.

6.2.4 Artifacts

Access was gained to, *inter alia,* the complete and/or incomplete students' products, assignments, portfolios, test scripts, peer and self-assessment sheets in the FDE. Some of the students' models and some of the students' completed assignments and assessment sheets in the FDE were photographed. In addition, there was access to all the portfolios developed by students in the FDE. The students' portfolios provided an account of their experiences in the FDE for purpose of triangulation with other data sources like field notes and interview data.

There was access to the learners' work during the lessons and photocopies were made of some of the learners' work in the two schools visited. On the visits to the two schools, photographs of the schools' environments were taken to illustrate descriptions of the disadvantages still being experienced in these schools.

The artifacts provided a broader perspective of the students' and learners' capabilities and their understanding of the concepts covered during lecture sessions or lessons. The artifacts also corroborate evidence from other data sources (as discussed in Chapter 4 section 4.3.4).

The process whereby the data were analysed in this research will now be discussed.

6.3 Data Analysis

It is the view of some researchers that in qualitative field studies "analysis is conceived as an *emergent* product of a process of gradual induction" (Lofland and Lofland 1995:181). In keeping with this view, the following process of data analysis was used to interpret the data in this research.

6.3.1 Step One: Reading the data

The relevant data pertaining to each of the four modules in the FDE was organised chronologically in date order from July 1999 to November 2000. The data from the school context was filed separately for each of the two schools and for each lesson presented by the different educators. To familiarise the researcher with the data, all the field notes, interview transcripts, documents and other materials for the four FDE Modules and the Technology lessons in the two schools were read and reread.

6.3.2 Step Two: Initial data coding and identification of contradictions

According to Taylor and Bogden, the coding process "is a systematic way of developing and refining interpretations of the data" (Taylor and Bogden 1984:136), whilst Miles and Huberman contend that codes may be viewed as:

> ... tags or labels for assigning units of meaning to the descriptive or inferential information compiled during the study. Codes usually are attached to ... words, phrases, sentences or whole paragraphs, connected or unconnected to a specific setting.
>
> Miles and Huberman (1984:56)

The 'elements' identified in Engeström's Activity Systems were used to initially codify the data in the four Modules in the FDE and the Technology lessons in the two schools namely, 'subject', 'object', 'tool', 'rule', 'community' and 'division of labour' (Engeström 1987:256). Words, phrases and/or sentences that were associated with any of these key 'elements' were highlighted in the field notes. Whilst coding the data a preliminarily identification of the four levels of contradictions was made (as described in Chapter 5 section 5.1.3) and suggested by The Centre for Activity Theory and Developmental Research (1998b:unpaged).

6.3.3 Step Three: Refining data codes, re-coding data and adjusting contradictions

It was clear from the initial coding that the codes needed to be refined since the coded 'elements' were too broad and did not effectively describe the data within each of the 'elements'. Similar related words and phrases that were initially identified within each of the 'elements' were grouped and regrouped, and renamed more appropriately. Different codes for the FDE were developed as shown in Table 7.

Table 7. The list of codes for each 'element' in the FDE

Elements	Code	Referring to
Tool – refers to conceptual and material or equipment mediators that help to achieve the 'object' of the activity.	LecCtool	Lecturer conceptual tool
	LecEtool	Lecturer equipment tool
	StuCtool	Student conceptual tool
	StuEtool	Student equipment tool
	Utool	University tools
	NGOtool	NGO tool
Rule – refers to the explicit and implicit regulations, norms and conventions that constrain or enable actions and interventions within the activity.	Lecrule	Lecturer rule
	Sturule	Student rule
	Urule	University rule
Community – compromises multiple individuals an/or sub-groups who share the same general 'object' of the activity.	UComm	University Community
	NGOComm	NGO Community
	BComm	Broader Community
	SSComm	School Community
Division of Labour – refers to both the division of tasks and roles between the individuals and the broader community associated with the activity.	LecDOL	Lecturer division of labour
	StuDOL	Student division of labour
	UDOL	University division of labour
	NGODOL	NGO division of labour

Since each module in the FDE consisted of a series of lecture sessions, the field notes for each lecture session were coded separately as indicated in Table 7. The relevant data from the field notes were then tabulated for all the lecture sessions within the particular Module according to the renamed codes. At the same time, the 'contradictions' were re-numbered according to the renamed codes for all the lecture sessions thereby establishing a pattern of 'contradictions' for the whole Module as well as for the individual lecture session.

Each school lesson was coded separately in the same way using the refined codes shown in Table 8. After which the 'contradictions' were identified and re-numbered according to the renamed codes for each Technology lesson.

Table 8. The list of codes for each 'element' in the school context

Elements	Code	Referring to
Tool – refers to conceptual and material or equipment mediators that help to achieve the 'object' of the activity.	ECtool	Educator conceptual tool
	EEtool	Educator equipment tool
	LCtool	Learner conceptual tool
	LEtool	Learner equipment tool
	Stool	School tools
	DEtool	Department of Education tool
Rule – refers to the explicit and implicit regulations, norms and conventions that constrain or enable actions and interventions within an Activity System	Erule	Educator rule
	Lrule	Learner rule
	Srule	School rule
Community – compromises multiple individuals an/or sub-groups who share the same general 'object' of the activity.	PComm	Parent Community
	LComm	Larger Community
	DEComm	Department of Education Community
	SComm	Educators & learners in School
Division of Labour – refers to both the division of tasks and roles between the individuals and the broader community associated with the activity.	EDOL	Educator division of labour
	LDOL	Learner division of labour

6.3.4 Step Four: Checking coded data and contradictions

All the data were checked for a third time to ensure consistency across all the Modules in the FDE and the lessons in the school context. While checking the coded data and 'contradictions' new insights emerged through a hermeneutic circle-like process (discussed in Chapter 4 section 4.1). As a result of incorrect coding or failure to code in some instances more data for coding were identified or changed.

The coded data in the four Modules in the FDE and the two school lessons were checked again. The 'contradictions' were adjusted according to any code changes before being re-numbered for each of the four modules and each of the school lessons.

An independent coder checked the codes and 'contradictions' during the process of refining and renaming of the codes, and identifying the 'contradictions' in steps three to five. There was agreement on the interpretation of most of the codes. The 'tool' and 'rule' elements however were sometimes problematic to interpret. For example, the FDE or school time-table could either be a 'tool' or a 'rule' depending on how the 'subject' used it in the Activity System. In the instances where our interpretations differed we reached a consensus interpretation.

An example of the coded data in the Education lecture session on the Curriculum on 9 July 1999 in the FDE Activity System is shown in the extract in Table 9 (see the following page).

Table 9. An extract from the coded Education Module

Element	Code	09/07/1999	Contradictions
Object	Object	Curriculum -To review previous session and assignment -To take attendance register -To discuss C2005 and OBE in relation to 'old way' -To discuss curriculum theory -To explore philosophical roots of 'old' and 'new' -To explore main elements of C2005 and OBE -To explore elements of OBE lesson planning -To design OBE lesson -To discuss assignment 2	1. The students (subjects) are not sure how to plan an OBE lesson (StuCtool) 2. The students (subjects) take a long time to reach consensus on how to design an OBE lesson (StuDOL) and there is not enough time to complete the task (Lecrule) 3. The lecturer (subject) cannot effectively facilitate 120 FDE students in groups (LecDOL) to grasp the OBE lesson task (StuCtool) 4. The lecturer (subject) does not give the students the assessment criteria (LecDOL) for the OBE lesson planning assignment (Lecrule)
Tool	Utool	ABC at U	
	LecEtool	Notes on course outline & assessment schedule, SA's new curriculum framework, LA specific outcomes, summary of old and new, general curriculum model, definitions of curriculum, the learning adventure; flip charts, kokis, newsprint, pens, pencils, rulers, desks arranged in groups	
	StuEtool	Notes, kokis, newsprint, pens, pencils, rulers	
	LecCtool	Buzz groups, C2005, OBE, curriculum, lesson planning, old and new approach, cognitive perspective, self actualisation, social reconstruction, academic rationality, Piaget, Bruner, Vygotsky, social constructivism, plan, act, evaluate	
	StuCtool	Understanding of C2005, OBE, curriculum, lesson planning, old and new approach, cognitive perspective, self actualisation, social reconstruction, academic rationality, Piaget, Bruner, Vygotsky, social constructivism, plan, act, evaluate	
Rule	Urule		
	Lecrule	-To follow programme designed for the day -Students do assignment 2 and submit in Sept 1999 -All FDE student together for this session (100 students) -Students reach consensus on OBE lesson	
	Sturule	-Talk in Xhosa in groups	

Community (COMM)	UComm	Provide Notes, newsprint, kokis	
	NGOComm		
	BComm	-Introduction by guest lecturer from ESST	
Division of labour (DOL)	LecDOL	-Guest lecturer introduces curriculum -Guest lecturer facilitates group feedback -Ed lecturer/FDE co-ord explains philosophical roots of old and new curriculum approach using students' input -Ed lecturer/FDE co-ord and students highlight elements of OBE and C2005 -Ed lecturer/FDE co-ord facilitates OBE lesson task	
	StuDOL	-Students listen to Guest introduction to curriculum -Students discuss definitions in group and plenary feedback -Students contribute to old and new approaches -Students listen and contribute to highlighting elements of OBE and C2005 -Students work in groups to design an OBE lesson whilst the Ed lecturer/FDE co-ord mediates	

The data from the Technology lesson in School A on 28 March 2001 in the school context were coded in a similar way as the FDE using the codes developed for the school context. The field notes for each lesson were coded as shown in the extract from one of the Technology lessons in Table 10 (see the following page).

Table 10. An extract from the coded Lesson A

FIELD NOTES	ACTIVITY THEORY ELEMENTS		CONTRADICTIONS
Technology Lesson A Grade 7 School A 28 March 2001	Subject	Educator A 60 Grade 7 learners	
When the learners have settled down in their groups, Educator A tells the learners to take out one Technology classwork book per group. He then writes Technology Task on the board and the date. A learner gets up and takes the bell off the educator's desk and goes outside to ring it. It is 09h45.	Erule LEtool Eetool LDOL	Learners sit desks arranged in groups One Technology classwork book Greenboard and chalk Learner rings bell	
Educator A in the meantime writes the following on the board *[the board has come loose on the one end so it wobbles when he writes]*: "Three villages in the Transkei region are damaged by a tornado. The roofs are the most affected. As a technologist what can you do to rescue this problem?" Educator A tells the learners that they are technologists and he reads the problem to them then says, "What can you do to rescue the problem?" but before anyone can say anything he asks another question "What is a tornado?" Many hands go up and Educator A asks a boy near the front of the class to answer. The boy gives the answer in Xhosa and Educator A looks to me and says, "the learners know". Educator A then again reads the problem from the board and says to the class before writing on the board, "use the eleven technological processes to solve the problem". He then turns to the class and says, "in your groups you need to solve the problem using the eleven technological processes". He tells the learners that each group must nominate a group leader; each group must have a scribe who must write down what the group discusses in the rough workbook; and there must be a judge "to see that everything is in order and that everyone is participating". The learners immediately start to chat. The educator then starts to give each group a letter A, B, C etc to K and tells the class that they have 15 minutes ...	EDOL LDOL ECtool ECtool & LCtool EDOL LDOL Object Object ECtool Erule EDOL LDOL ECtool & LCtool Erule EDOL	Educator writes on board while learners find one book to take out Scenario Concept of technologist & tornado Educator writes on board while learners listen To use the steps in the technological process to solve the "problem" To be a technologist Educator uses questioning Learners put hands up Educator asks questions and learner(s) answer Xhosa/English language Speak/write in English Educator reads problem to class	1. The educator (subject) does not pose a problem appropriate for Grade 7 learners (ECtool) 2. The educator (subject) does not give enough information (ECtool) for the learners to engage with the task in any meaningful way (LDOL) 3. The learner (subject) replies in Xhosa (LCtool) and not in English (Erule) 4. The educator (subject) incorrectly refers to technological processes (ECtool) instead of '11 steps in the technological process'

6.3.5 Step Five: Diagrammatically representing coded contradictions

Once the codes and contradictions in the FDE Modules and the school lessons had been checked for a fourth time the coded and numbered contradictions were represented diagrammatically as illustrated in Figure 6 for the Education Activity System contradictions [see Appendix O for details concerning the contradictions]. Each numbered contradiction was placed on the diagram according to the code developed in Table 7. The numbered contradictions were placed on the diagram next to the tool, rule, community or division of labour 'element' in the case of primary contradictions, and between the 'elements' as tool-rule, tool-division of labour, tool-community, rule-community, rule-division of labour and community-division of labour contradictions, in the case of secondary contradictions.

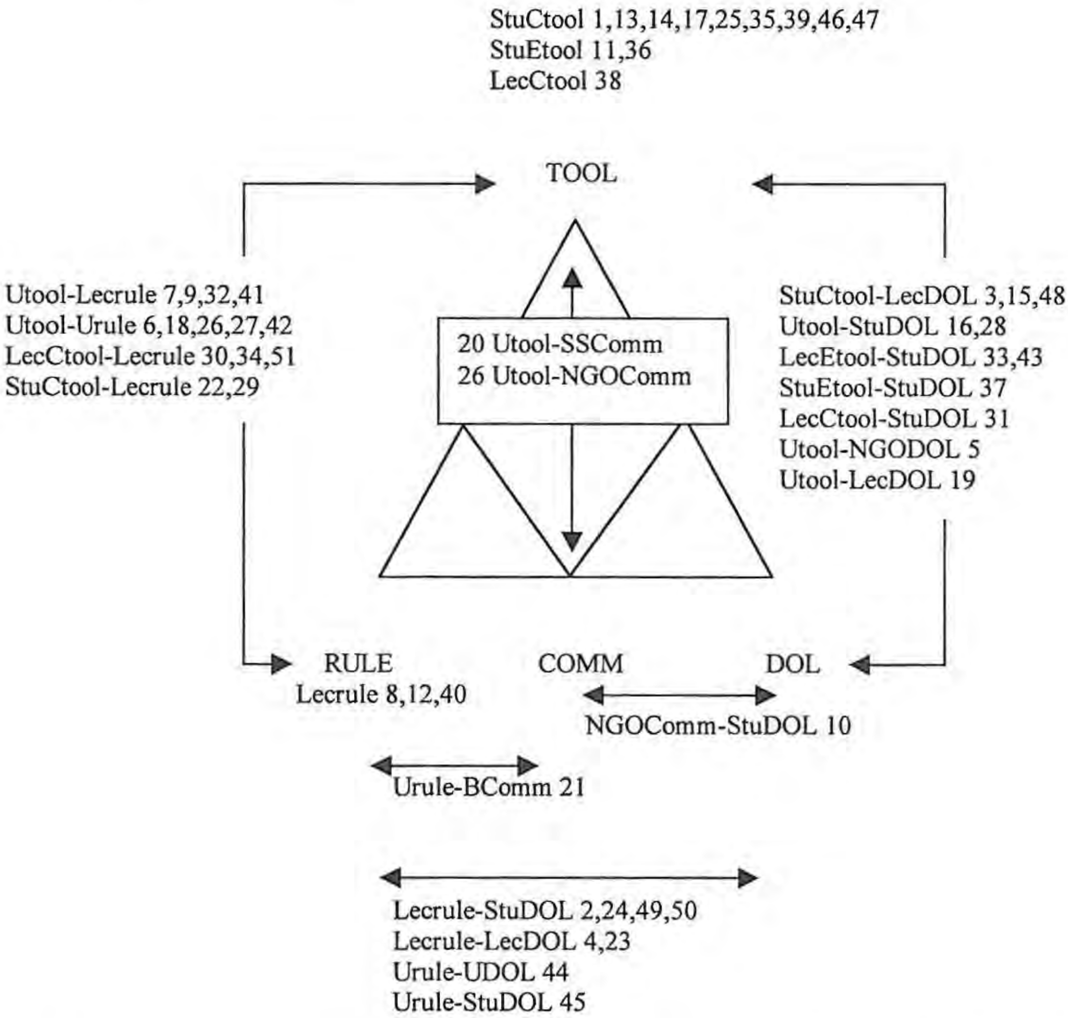


Figure 6. A diagrammatic representation of the coded and numbered contradictions in the Education Activity System

The coded and numbered contradictions for Lesson A are illustrated in Figure 7 and developed in Table 8 [see Appendix P for additional details of the contradictions]:

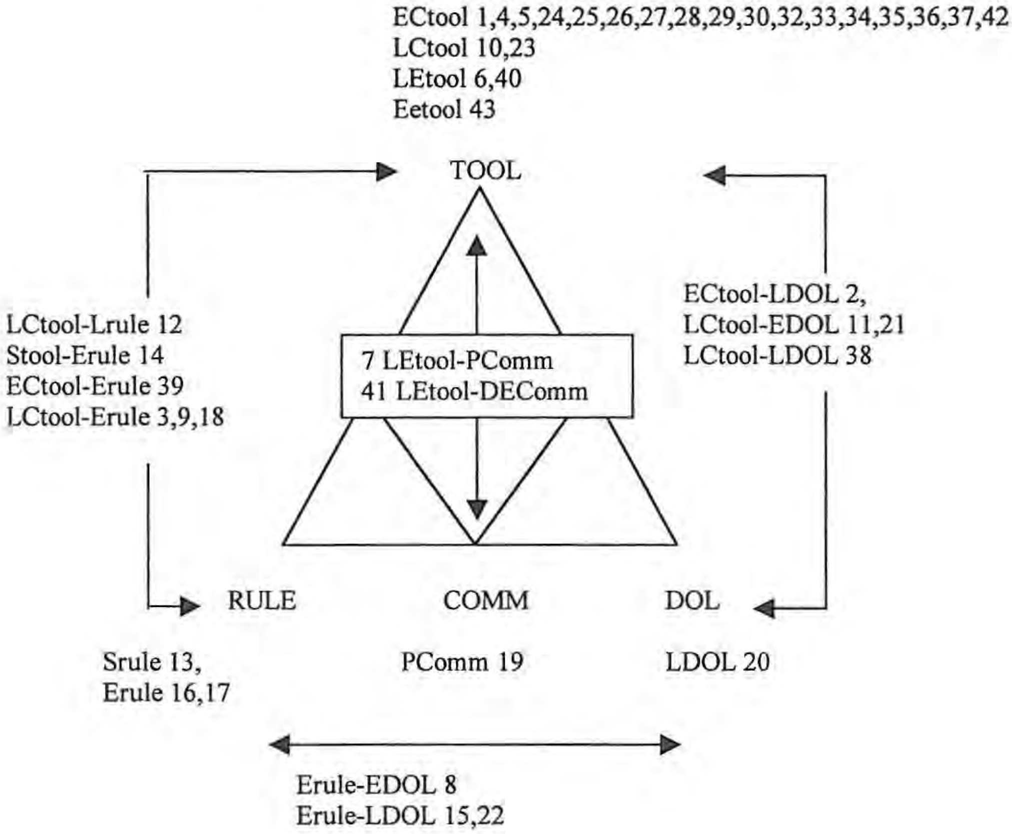


Figure 7. A diagrammatic representation of the coded and numbered contradictions in Lesson A

The next step in analysing the data was to develop themes within and across the Modules and Lessons from the coded data.

6.3.6 Step Six: Developing themes from the coded data

The diagrammatic representations of the coded 'elements' and the numbered 'contradictions' in the FDE Activity System and the School Lessons served as the basis to develop themes that ran within and across the Modules and lessons for the discussion of the research findings. There was a conscious linking of the smaller units of analysis namely, the Modules in the FDE and the lessons in the schools, to the larger unit of analysis, in-service educator educational policy, when discussing the data. Extracts from field notes, interviews, documents, artifacts and photographic material that supported the 'contradictions' and themes that emerged from the coded data were selected and included in the thesis text. Conclusions were drawn from the findings in the FDE and the school context.

6.4 Verification

Verification and ethical issues do not belong in separate stages of an investigation but should be addressed throughout the entire research process. Ethical issues like trustworthiness, consistency and generalisability and research ethics that pertained to this research will now be examined.

6.4.1 Trustworthiness

To a large extent credibility and trustworthiness in interpretive research rests on how thoughtfully and dependably the researcher conducted the research (as discussed in Chapter 4 in section 4.4.1). In this study credibility and trustworthiness was ensured through the collection of "*multiple sources of evidence*" and the establishment of a convergent "*chain of evidence*" during data collection (Yin 1984:42). A critical outlook on the analysis was also adopted and, as far as possible, explicit statements were made of how the research was conducted and how the understanding and interpretation of the events and phenomena under investigation were arrived at. The extended involvement as a participant observer over a two-year period also contributed to the dependability of the interpretations.

6.4.2 Consistency

Consistency is an important aspect of any research particularly in interpretive research (as elaborated on in section 4.4.2 in Chapter 4). In this study consistency was ensured through the researcher's prolonged involvement through participant observation and interviewing participants and role players over a two-year period. Where applicable, extracts of field notes and/or transcribed interviews have been included in the text to lend substance to the interpretations of the events and activities during the period of this research. In addition, an independent individual checked the coded data and confirmed the contradictions that had been identified to ensure dependability of the interpretations.

6.4.3 Applicability

The aim of this research was to gain an understanding of the implementation of educational policy in INSET and the practise of participating educators, and not to generalise the findings to other contexts. For this reason, "rich and thick descriptions of [the] theoretical and methodological orientation" as suggested by Rossman and Rallis (1998:47) have been provided in this research as suggested for interpretive research and discussed in Chapter 4 in section 4.4.3. In addition, as much detail of the context, research process and interpretations of the phenomena under investigation as possible have been provided so that the reader may consider whether the findings of this research may be applicable in a different context.

6.5 Research ethics

Ethical issues arose throughout the entire research process and not only at the data collection stage. "Informed consent" (Kvale 1996:112) was obtained from all the participants involved in this research and the participants' confidentiality has been ensured by not naming or identifying them. In addition, information that was shared in confidence has not been reported on.

6.6 Limitations of this research

Activity Theory was a useful conceptual framework for this research, for the reasons given in Chapter 5 section 5.2. Activity Theory however only focuses on the contradictions that emerge in an activity and not on the interactions within and between the 'elements' that do not result in tensions or contradictions. The research findings thus only focus on the aspects of the teaching and learning activities in the FDE and the classroom that had the potential, through their *transformative ability*, to lead to change and not on 'best practices' that may inform Technology INSET programmes.

A factor that may have contributed to the limitations in this research is that the researcher did not speak Xhosa and was not able to understand what the Xhosa speaking participants were discussing whilst conducting the research. The researcher had to rely on the participants to speak English and the participants may have been selective in expressing what they wanted the researcher to hear. In addition, the participants may not have been able to express themselves as well in their second language as they would have in their mother tongue, thus perhaps influencing the researcher's interpretation of the participants' actions.

This chapter has served to outline the research process and the possible limitations of the research. The findings of the research with regard to the 'object' of the FDE are presented and discussed in the next chapter.

Chapter 7 Findings and Discussion – The 'object' of the larger FDE Activity System

Most activities are directed at the achievement of particular goals. Since action is dynamic these goals are not necessarily constant but may shift. Activity Theory uses the term 'object' to refer to the goal at which the activity is directed. Different 'subjects' involved in the activity do not necessarily share a common understanding of the goals. These may lead to potential tensions, which can affect the processes operating when people engage in an activity. The FDE may be understood as an Activity System hereafter referred to as the larger FDE Activity System. In this chapter the 'object' of the larger FDE Activity System is explored. The different subjects' (lecturers and students) understanding of the 'object' of the larger FDE Activity System and the four Modules, are examined to reveal contradictions and consistencies.

In the process of analysing the data, each of the four Modules in the larger FDE Activity System namely, Technology, Science, Mathematics and Education, was taken to be an Activity System. Each of the four Activity Systems had specific 'objects' and a range of activities to achieve those 'objects'. The 'objects' of the Technology, Science, Mathematics and Education Activity Systems contributed to the achievement of the 'object' of the larger FDE Activity System.

7.1 The lecturers' understanding of the 'object' of the larger FDE Activity System

The NGO lecturer's view of the 'object' for the larger FDE Activity System was articulated, in line with educational policy, as meeting the needs of the workplace:

> We need people who are academically qualified in Math, Science and Technology because that is the world in which we are operating. We must be technologically literate or else we'll be left behind. Lots of jobs are under threat and therefore there is a need to upgrade qualifications in order to keep experienced teachers and liberate teachers and practitioners.
>
> Interview NGO lecturer (31 August 1999)

The NGO lecturer's understanding of the 'object' of the larger FDE Activity System reflected the need to satisfy labour force productivity, which is also the NGO's philosophy of empowering communities by providing people with job creation skills and employment (NGO *Education for Life* no date:unpaged). The NGO lecturer's view was sensitive to the fact that jobs were being transformed or becoming obsolete as a result of the introduction of Technology (Lewis 1996:50).

Although no outcomes were developed for the Technology Activity System the NGO lecturer elaborated on the three 'objects' that he had identified for the Technology Activity System and how he intended achieving these:

> [Firstly] To develop people's capacity to solve problems. This is done by creating context driven needs or problem conditions and then giving the students the opportunity to do research ... develop their motor skills ... investigate things and then come up with tangible and hopefully correct answers ... viable answers. Of course ... there is not necessarily one solution, but there may be one best solution. But we can reach those conclusions through consensus ... [Secondly] To develop people's designing, making and evaluating skills and knowledge ... [Thirdly] To develop in people the capacity to integrate their hands and knowledge with the more academic or theoretical content of the programme ...
>
> Interview NGO lecturer (26 August 1999)

The NGO lecturer's view of Technology was in line with educational policy and reflected a cognitive view of problem-solving (Olson 1997:384) and an economic 'skills' perspective suggested by Lewis (1996:48), Spenner (1985:135) and Hyland (1997:173).

The 'objects' of the Science and Mathematics Modules as 'minor subjects' in the larger FDE Activity System were conceptualised to give the student an understanding of the scientific and mathematical concepts respectively that underpinned the Technology Module as the 'major subject' in the larger FDE Activity System. This approach was in line with educational policy where Technology draws on Science and Mathematics (S.A. DoE 1997h:28).

The NGO lecturer expressed the 'object' of the Science Activity Systems as an opportunity to develop the students' creativity. "In the Science class there is development of content but there is also a development of procedure and opportunities to experiment ...

opportunities to create" (Interview NGO lecturer 26 August 1999) while the 'object' of the Mathematics Activity System was stated as:

> In the math classes the focus in not so much on the development of math content, although of course that is important. It is about bringing a new awareness to what mathematics is all about and developing core skills in the math students. We don't intend to make mathematicians out of them. They walk out of the FDE qualified as Technology Education teachers but both math and science require attention because by its very nature Technology requires inputs from math and science and other learning areas.
>
> Interview NGO lecturer (16 August 1999)

The University FDE syllabus (1998) was designed, in line with educational policy, to integrate the relevant scientific and mathematical concepts into the Technology Activity System. The topics in the Technology, Science and Mathematics syllabi corresponded with the eight 'terms' over the two-year duration of the FDE [see Appendix J for the University FDE syllabus (1998)].

Whilst the Education Activity System was conceptualised to underpin and be integrated with the Technology, Science and Mathematics Activity Systems, the 'object' of the Education Activity System was also intended to meet the needs of educators with a minimum M+3 qualification as indicated in educational policy:

> It is assumed that the 'traditional' course work in General Education Theory was done in earlier teacher Diploma studies, namely, foundation courses in philosophy, psychology, history and sociology of education. This course will therefore avoid this 'traditional' approach in its curriculum design. Instead, the teacher-learners [students] and course facilitator [lecturer] have engaged in exercises and discussions in order to co-construct a course that meets 2 *[sic]* goals:
>
> 1. To provide teacher-learners with recent thinking and research in education theory that derive from the traditional domains mentioned above;
> 2. To respond to and support teachers' needs in their classroom and school situations through an examination and understanding of relevant educational theory.
>
> University FDE Education Course Guide (1999c:unpaged)

The Education lecturer/FDE co-ordinator further stated that her role would be "to raise teacher-learners' awareness both of theory and context as well as pedagogical processes and skills in educational studies" (University FDE Education Course Guide 1999c:unpaged). The 'object' of the Education Activity System thus seemed to have a theoretical focus that was not explicitly integrated with the Technology, Science and Mathematics Activity Systems [see Appendix Q for the University FDE Education Course Guide (1999-2000)].

7.2 The students' understanding of the 'object' of the larger FDE Activity System

All the students enrolled in the larger FDE Activity System had an M+3 qualification and were Xhosa second language English speakers. Some of the students had a limited understanding of Science and Mathematics since they had studied Science and Mathematics at school to Grade 10 or 12 whilst quite a few students were knowledgeable Mathematics and Science educators.

The students' understanding of the larger FDE Activity system indicated that they were conscious of labour market needs. The majority of students enrolled for the FDE to upgrade their qualifications and/or 're-skill' in the area of Technology. One FDE student explained: "The advertisement was saying 'Equip yourself with Technology Education' and it was pointing to educationists and we said 'Wow! That is an opportunity to learn whilst working' ... Technology is in demand and everybody wants to do the Technology Education Diploma" (Interview FDE student 31 August 1999).

In addition, the students' linked the 'object' of the larger FDE Activity System to improving professional practice, which reflected educational policy in COTEP (1998) and the S. A. Government Gazette (2000). Most of the students' viewed the 'object' of the larger FDE Activity as equipping themselves with knowledge and skills in the Technology learning area to be effective in the classroom teaching and learning environment. One student expressed the view of many of the students, which was to gain "knowledge in Technology Education and skills in teaching the learning area ...[and] creativity so as to guide my learners" (Interview FDE student 31 July 1999). Another student said "I think I will be able to teach Technology in future ... and I think I will be ready to teach Curriculum 2005 which is OBE" (Interview FDE student 7 July 1999). Yet another student expressed the hope that "I will have skills which I will apply in the classroom situation so that our children will be marketable in future" (Interview FDE student 31 July 1999).

Some of the students envisaged the FDE as a way of gaining access to further study. One student put it this way "I wanted to improve my qualification as an educator and I also was interested in Technology ... I also regarded the FDE as the only vehicle that can carry me to my destination which is B.Ed" (Interview FDE student 7 July 1999). One of the aims of the NQF is to promote articulation and learning pathways to enable learners to become part of a society of lifelong learners (Malan 1997:5). Whilst the FDE was advertised as a an access route to a B. Ed (Honours) degree, this aspect was not explicit in the lecturers' understanding of the 'object' of the larger FDE Activity System.

Other students enrolled for the FDE to receive a certificate and the accompanying financial rewards and were less interested in learning about Technology. One of the students commented in her portfolio:

> Even some of my classmates at the moment are interested in satificates *[sic]*, not knowledge. I don't think they are interested in knowledge. They are just interested in the money they are going to get when they pass the course. I don't say there should not be incentives but if they [incentives] can be based on productivity. The productivity should be measured on the basis of output.
>
> FDE student Portfolio (2000)

Unfortunately the students were not able to articulate the 'object' of the Science and Mathematics Activity System possibly since they mistakenly thought that Technology was linked to Information Technology and did not relate Science and Mathematics to Information Technology.

7.3 Consistency between the lecturers' and students' views

There seemed to be a convergence between educational policy to develop skills to prepare individuals for the world of work in a rapidly changing technological world (S.A. DoE 1997h:3) and the 'object' of the larger FDE Activity System to create a technologically literate workforce to enhance the economy of South Africa (Interview NGO lecturer 31 August 1999). The students shared the intention of educational policy and the 'object' of the larger FDE Activity System to upgrade their qualifications, to be awarded a certificate on successful completion of the FDE and for the students to be more 'marketable' as a result. Since the students co-constructed the curriculum for the Education Module there was consistency between the students' and the lecturer's understanding of the 'object' of the Education Activity System.

There were however, inconsistencies between the lecturers' and the students' understanding of the 'objects' of the larger FDE Activity System in relation to educational policy.

7.4 Inconsistency between the lecturers' and students' views

The lecturers' and students' understanding of the 'object' of the larger FDE Activity System differed in relation to six issues.

Firstly, the students had their own understanding of Technology that was different from that articulated in Curriculum 2005 and expressed by the NGO lecturer. One student said:

> By the time I registered for this course I thought that I would be dealing with technological appliances like computers, telefax, internet and many other things. But immediately I came to the Technology class I was surprised to find out that Technology is not only about computers ... I discovered that Technology is a process. It is about skills and knowledge that needs to be developed ...
>
> FDE student Portfolio (2000)

Another student had a similar understanding of Technology:

> Prior [to] enrolling for the FDE, my perception was that the course content of the whole programme would include I.T. [Information Technology] which was the area of my interest. But then, it didn't dampen my spirits ... I learned that Technology, as a school learning area of the outcomes-based education, is interesting and dynamic.
>
> FDE student Portfolio (2000)

Whilst the larger FDE Activity System did not focus on Information Technology entirely as the students anticipated, the Technology Module did include 32 hours of computer training in the second year of study. This research however does not report on the computer training since three students had access to computers and most of the schools in the Eastern Cape Province do not have electricity therefore computer training would be difficult to implement in their schools.

The students' understanding of Technology as Information Technology reflected the misunderstanding and confusion of many people who associate the term 'Technology' with computers, as indicated by Boser (1993:unpaged). Furthermore, the students were not aware that their understanding of Technology was different from that expressed in educational policy and the 'object' of the larger FDE Activity System until they attended the lecture sessions. As the students came to a new understanding of Technology in time, the contradiction between the 'object' of the larger FDE Activity System and the students' initial understanding of the 'object' of the lager FDE Activity System was to some extent resolved.

Secondly, since some of the students were only interested in obtaining a certificate and not particularly interested in being Technology learning area specialists, this may have contributed to tensions or contradictions arising in the teaching and learning activity that became unmanageable. These students may not have been motivated to meet the requirements of the larger FDE Activity System by arriving late for lecture sessions (see Chapter 9 section 9.2.1), not bringing their equipment to the lecture sessions (see Chapter 9 section 9.2.2) and completing the tasks during the lecture sessions (see Chapter 9 section 9.2.3).

Thirdly, differences arose between the NGO lecturer's view of the 'object' of the larger FDE Activity System and educational policy in respect of re-educating educators to meet the educational policy requirements of Curriculum 2005 and OBE. The difference between educational policy and the 'object' of the larger FDE Activity System may have come about when the larger FDE Activity System was conceptualised prior to 1996 when the INSET emphasis was mainly on the transfer of content knowledge to meet COTEP (1994, 1996) requirements. With the change in educational policy to a competence-based approach (COTEP 1998 and S.A. Government Gazette 2000) in line with the introduction of outcomes-based education, INSET's focus was on the development of the students' ability to demonstrate their knowledge and skills whilst teaching Technology effectively to facilitate learning. As a result of the change in educational policy, the 'object' of the larger FDE Activity System had a 'content knowledge' focus that was not specifically aimed at the new educational policy that required educators to demonstrate the roles and competences in COTEP (1998) and S. A. Government Gazette (2000) to improve classroom practice [see Appendix F for the roles and applied competences in COTEP (1998:68-80) and Appendix I for the roles in S. A. Government Gazette (2000:13-22)].

The students anticipated that the 'object' of the larger FDE Activity System would be to prepare them for Curriculum 2005 and OBE by developing their knowledge and skills as Technology learning area specialists. The students' understanding of the 'object' of the larger FDE Activity System was in line with educational policy in that the focus was on the development of knowledge and skills in preparation for teaching Technology in Curriculum 2005 with an OBE approach. The students' understanding was however limited since they were not familiar with the roles and applied competences requirements of educational policy.

The difference between the students' view of the 'object' of the FDE Activity System, to improve their knowledge and skills in OBE, may have been exacerbated by the 'object' of the FDE Activity System having a 'content knowledge' and not an OBE focus. The lecturers' concerns for delivering the 'content' in the University FDE syllabus (1998) may have created tensions in the teaching and learning activity since the lecturers were not able to spend sufficient time on the process of student learning required in OBE which is more time consuming than teaching 'content knowledge'. When a more deliberate outcomes-based approach was adopted in the larger FDE Activity System in the second year of study, some of these contradictions may have been resolved. Other tensions however, emerged as a result of the lecturers' inexperience in implementing an outcomes-based approach in the larger FDE Activity System.

Fourthly, whilst educational policy explicitly linked Science and Mathematics to Technology (S.A. DoE 1997h:28) tensions arose when the students were not able to make the connection between the 'object' of the larger FDE Activity System and Technology due to their inadequate understanding of Technology. In addition, some of the students had very little prior knowledge of Science and Mathematics to draw on to inform their understanding of Technology. The tensions that arose between the 'object' of the larger Activity System and the students' understanding of Science, Mathematics and Technology may have been too great for the NGO lecturer to resolve.

Fifthly, the assumption that students with an M+3 qualification will have the knowledge and skills to cope with the FDE level of education is implicit in educational policy (COTEP 1996, 1998 and S. A. Government Gazette 2000), which was reflected in the 'object' of the larger FDE Activity System. Educational policy does not however take into account that apartheid education has left many students under-prepared for tertiary studies. Tensions arose in the teaching and learning activity that may have been difficult to manage when the lecturers were expected to bridge the gap in the students' knowledge and skills and also facilitate the students' learning to meet the requirements of the 'object' of the larger FDE Activity System.

Lastly, the students anticipated that the FDE would prepare them for access to further studies at B. Ed level in line with the NQF to promote articulation and access to lifelong learning. However, neither the NGO lecturer nor the co-constructed Education curriculum explicitly articulated developing research and academic writing skills as an 'object' of the larger FDE Activity System which may have resulted in contradictions emerging in the FDE Activity System.

The lecturers' and students' understanding of the 'object' of the larger FDE Activity System have been discussed in this chapter in relation to educational policy. In the following chapter the contradictions concerning the 'tool' element in relation to the 'object' of the larger FDE Activity System will be discussed.

Chapter 8 Findings and Discussion – The 'tool' element

As stated earlier, in the process of analysing the data, each of the four Modules in the larger FDE Activity System was taken to be an Activity System. Each of the four Activity Systems had specific aims and a range of activities to achieve those aims (as described in Chapter 7). In terms of Activity Theory the actions and activities in the four Activity Systems may be understood through their 'elements' namely, 'tools', 'rules', 'division of labour' and 'community'. Activity Theory attempts to understand the dynamics of the Activity System by identifying the contradictions or disturbances within 'elements' and across 'subjects' with regards to the 'elements'. It is in the exploration of the contradictions or tensions that the dynamics of the Activity System are revealed and it is through seeking the moments of disequilibria that the opportunities for transformation come about (as discussed in Chapter 5 section 5.1.3).

Whilst all the contradictions in the four Activity Systems were analysed, only the contradictions pertinent to the 'tool' element' in the four Activity Systems will be referred to in this chapter for both lecturers and students, where applicable [see Appendix R, S, T and O for details of the contradictions in the Technology, Science, Mathematics and Education Activity Systems respectively]. The contradictions 'within' and 'between' the remaining 'elements' will be discussed in subsequent chapters.

In an activity, 'tools' are important mediators that act as intermediaries between environmental stimuli and an individual's response to the stimuli (Bodrova and Leong 1996:69). The conceptual 'tools' may be words, concepts and ideas that may be used automatically, without conscious thought, or deliberately, to help individuals master their own behaviour to allow them to adapt to their environment. Mental tools may also make higher mental processing easier and more effective. Material or equipment 'tools' such as pictures, calculators and textbooks are also 'tools' that individuals may use to trigger the development of higher mental functioning or to extend their capacities (see Chapter 5 section 5.1.1).

In the larger FDE Activity System a number of 'tools' were used in the teaching and learning activities in the four Activity Systems. A large number of contradictions occurred within the 'tool' element across the four Activity Systems. These contradictions *mainly* concerned the students' conceptual 'tools', however, where contradictions concerning the lecturers' conceptual 'tools' emerged that may have contributed to the students' conceptual 'tool' contradictions, these are documented.

8.1 The students' conceptual 'tool' contradictions

The nature of the students' conceptual 'tool' contradictions were not the same across all four of the Activity Systems. The fact that the students' were under-prepared for tertiary study at the FDE level (NQF level 6 in HET Band), despite being qualified educators, contributed to a number of students' conceptual 'tool' contradictions occurring.

All the students were Xhosa second language English speakers who had a minimum of an M+3 qualification, yet most of the students were under-prepared with respect to the conceptual 'tools' required in the larger FDE Activity System. Most of the students were under-prepared not only because of the poor quality of the education they had received, but also due to the socio-economic conditions in the Eastern Cape Province (as described in Chapter 3). The students' actions therefore need to be seen in relation to their socio-historical context and the negative influence apartheid education had on their cognitive and developmental processes.

8.1.1 'Concepts and terminology' contradictions

The contradictions that occurred between the 'object' of all four Activity Systems and the students' inability to use concepts adequately in each of the Activity Systems are shown in Table 11. Those instances where the lecturers' conceptual 'tools' may not have adequately developed the students' conceptual understanding are reported.

Table 11. A description of the 'concepts and terminology' contradictions in all four Activity Systems

STUDENTS' 'CONCEPS & TERMINOLOGY' CONTRADICTIONS	
Activity System	**Description**
Technology	22-The students (subjects) are not able to identify different wood products (StuCtool) 23-The students (subjects) are confused by the difference between "blocks of wood" and "block wood" (StuCtool) 70-The students (subjects) do not know what is meant by a 'capability task' mentioned in the portfolio (StuCtool) 95-The students (subjects) do not understand the terminology used in the hydraulic rubric (StuCtool)
Science	12-The students (subjects) are not able to explain what happens in the experiments, e.g. to a gas when it is heated and cooled, how a thermometer works, the effect of cooling on different liquids (StuCtool) 19-The students (subjects) are unable to explain their observations of evaporation and temperature (StuCtool) after doing the experiment 41-The students (subjects) are confused because the textbook uses N/mm2 and this does not equal Pascal whereas N/m2 does (StuCtool) 59-The students (subjects) have problems understanding the terminology VR & MA (StuCtool) in textbook 68-The students (subjects) do not know how to diagrammatically represent the atomic model (StuCtool) dealt with in previous lectures 75-The students (subjects) do not know how to use and read the voltmeter and ammeter (StuCtool) even after the guest lecturer's explanation
Mathematics	1-The students (subjects) are not familiar with tangram and Pascal's triangle (StuCtool) 10-Some students (subjects) are not familiar with equivalency and applying BODMAS (StuCtool) 27-The students (subjects) do not know the difference between 'rounding off' and 'recurring' (StuCtool) 32-The students (subjects) confuse and interchange lower and upper case letter in cm, mm (StuCtool) 36-Some students (subjects) are not sure of the meaning of 'base' and 'perpendicular height' (StuCtool) 37-Some students (subjects) confused by 'b' in 'base' with the 'b' in h=0,5b (StuCtool) 65-Some students (subjects) confuse N (newtons) and N (rotational frequency) (StuCtool) 66-The students (subjects) are confused by all the different formulae (StuCtool) 76-The students (subjects) have difficulty understanding the notes on handling volumes (StuCtool)
Education	1-The students (subjects) are not sure how to plan an OBE lesson (StuCtool) 13-The students (subjects) have not heard of multiple intelligences and learning styles and do not know how to apply it in practice (StuCtool) 14-The lecturer (subject) assumes that the students know about learning theories, however, not all the students do (StuCtool) 17-The students (subjects) were not aware of barriers to learning and learners with special needs (StuCtool) 25-The students (subjects) are not familiar with the COTEP document and roles of educators (StuCtool 39-The students (subjects) are not sure of the difference between assessment and evaluation (StuCtool)
LECTURERS' 'CONCEPTS & TERMINOLOGY' CONTRADICTIONS	
Technology	38-The lecturer (subject) refers to 'materials' and 'equipment' interchangeably without clarifying the meaning (LecCtool)
Science	11-The lecturer (subject) does not explain the scientific principles underlying the experiments (LecCtool) before the students do the experiments 18-The lecturer (subject) does not explain the scientific principles underlying the experiment (LecCtool) before the students do experiment 5.8 23-The lecturer (subject) is confused about water vapour and gaseous state (LecCtool) and students challenge his interpretation 27-The lecturer (subject) uses a cross-curricular learning opportunity in physics without adequate explanation of the concepts (LecCtool)

For the majority of the students, it was difficult to understand and use the core concepts in the four Modules as articulated by the lecturers. There was a gap between the lecturers' and the students' conceptual 'tools' that manifest in different ways.

Firstly, contradictions arose due to the students' unfamiliarity with the nuances of the English language [see Technology contradiction 23]. The NGO lecturer's command of the English language was good so he was not conscious of using terms that may have been difficult for the students to grasp, given the subtle differences in their meanings in different contexts [see Technology contradiction 38]. The students' under-preparedness and socio-historic context, and the fact that all the students were second language English speakers may have contributed to the students' language difficulties. Language is a cultural 'tool' that is shared and created by members of a particular culture that "is a distillation of the categories, concepts and modes of thinking of a culture" (Bodrova and Leong 1996:96). A process of sharing or talking to people facilitates the development of language and through the sharing process other mental 'tools' are acquired. For students learning in their second language, developing their English language skills may have been challenging since it involved acquiring and understanding a new set of cultural and mental constructs with new 'signs' and 'symbols' to mediate their thinking and learning. Without adequate language skills the students may have found it difficult grasping the concepts and terminology in the larger FDE Activity System on the one hand, and internalising these concepts to develop further learning, on the other hand.

Whilst one of the aims of INSET is to re-educate already qualified educators (COTEP 1996:118), educational policy does not take into account that the majority of educators may be second language English speakers who may face language difficulties. Difficulties with language places an additional burden on lecturers who are required to bridge the language gap whilst at the same time re-educate the educator in a new discipline (COTEP 1996:44). Few lecturers have the skills and time, particularly in part-time programmes, to adequately deal with both demands. Hence, the students had to cope with acquiring conceptual 'tools' without adequate language 'tools' to mediate their learning. Perhaps it is not possible in a two-year, part-time FDE to re-educate educators under these circumstances.

Secondly, contradictions arose when the students were not familiar with and did not have an adequate conceptual understanding of the terminology used in all four Activity Systems [see Science contradictions 41, 59, 68 and 75, Technology contradictions 22, 70 and 95, Mathematics contradictions 1, 10, 27, 32, 36, 37, 65, 66 and 76 and Education contradictions 1, 13, 14, 17, 25 and 39]. The Technology learning area aimed to develop "technological knowledge and skills" (S.A. DoE 1997h:12) through "a fundamental understanding of and ability to apply technological knowledge, skills and values ... in a range of technological contexts" (S.A. DoE 1997g:unpaged). The Technology learning area required mastering the nature, functions and application of materials, energy, information, safety, and information in systems and controls, communication, structures and processing (S.A. DoE 1997g:11). Acquiring new concepts and terminology requires higher mental functioning that is built on lower mental functions (Bodrova and Leong 1996:22). Since all the students were engaging with Technology for the first time they had to learn a whole range of technological, scientific and mathematical concepts and terminology with little or no prior knowledge to build on. Khumalo (1998:100) attributes this to apartheid education, which propagated vocational education for black people that resulted in a superficial awareness of Technology. Inadequate prior education may have contributed to these contradictions occurring since educational policy does not take into account that whilst the educators may be considered 'qualified' with an M+3 qualification, their qualifications may not adequately prepare them to engage in further studies at the FDE level.

Thirdly, a further contradiction arose when the students used the terminology inappropriately in the Science Activity System [see Science contradiction 12 and 19]. For example, one student used the term 'directly proportional' inappropriately to explain how the temperature drop related to evaporation:

> Alright, how is the temperature drop related to evaporation? Let us say that the temperature drop is directly proportional to the evaporation ... that is .. if the temperature drops ... ah hum ... if the temperature drop is high ... when there's ... when it is getting lower and lower, it means the evaporation is higher and higher.
>
> Interview FDE student (27 August 1999)

Another student explained the relationship between the drop in temperature and evaporation and used the term 'high kinetic energy' as follows:

> I think the temperature is dropping faster for the methylated spirits ... it has a higher rate of evaporation ... what causes evaporation ... that is the escaping of high kinetic energy ... and kinetic energy is related to temperature so, if high kinetic energy molecules are escaping then it means that the heat ... the actual temperature is dropping. So ... I think that is the reason why I say the methylated spirits has a high rate of evaporation, so it is loosing more ... high kinetic energy molecules.
>
> Interview FDE student (27 August 1999)

The 'self-discovery' approach in the Science Activity System, whilst being "curiosity driven" (S.A. DoE 1997h:26) may have contributed to the students' inadequate conceptual understanding of the scientific concepts, since the students did not have adequate prior knowledge on which to base their investigations whilst carrying out the experiments [see Science contradictions 11 and 18]. The students were also expected to understand and internalise concepts like 'energy', 'force', 'gravity', 'inertia', 'friction', 'velocity' and 'acceleration' whilst carrying out a cross-curricular activity in their groups [see Science contradiction 27]. These interventions may not have led to greater understanding for three reasons: the students did not have sufficient prior knowledge on which to build their understanding, there was not sufficient time for the students to repeat the tasks since competence and understanding are acquired after the task has been performed a number of times (Cazden 1981:5), and there was not enough time for the students to engage in a dialogue with their peers and lecturer to further develop their understanding. Whilst the NGO lecturer attempted to resolve the contradictions by improving the students' conceptual understanding by devising a revision worksheet that he discussed in a later lecture session [see Appendix U for Science revision worksheet], the students then challenged the NGO lecturer's explanation of water vapour and the gaseous state [see Science contradiction 23].

The conceptual 'tool' contradictions indicate that the students may not have adequately developed the content knowledge in Technology, Science, Mathematics and Education Activity Systems, to demonstrate their competence in the roles of Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22), designer and interpreter of learning programmes (COTEP 1998:73-74 and S.A. Government Gazette

2000:16-17), mediator of learning (COTEP 1998:71-73 and S.A. Government Gazette 2000:15-16) and assessor (S.A. Government Gazette 2000:21). The students may also not have been able to demonstrate the critical outcomes to communicate effectively using English language skills in the modes of oral and/or written presentation, solve problems, collect and analyse information, use Science and Technology effectively and understand the world as a set of related systems (S.A. DoE 1997b:16).

Further contradictions arose in the four Activity Systems as a result of the students' inadequate conceptual understanding of the concepts and terminology in the respective Activity Systems.

8.1.2 'Integration' contradictions

Contradictions emerged between the different 'elements' in all four Activity Systems concerning the students' inability to apply their knowledge and understanding of the concepts and terminology in the different Activity Systems. The instances where the lecturers' actions may have contributed to the students' conceptual 'tool' contradictions are documented. Table 12 shows the contradictions that occurred in the respective Activity Systems. The contradictions in bold refer to 'tertiary' contradictions that emerged as a result of a 'culturally more advanced object' namely, OBE being introduced into the four Activity Systems.

Table 12. A description of the 'integration' contradictions in all four Activity Systems

STUDENTS' 'INTEGRATION' CONTRADICTIONS	
Activity System	**Description**
Technology	57-The students (subjects) do not understand the difference between 'weight' and 'force' (StuCtool) 58-The students (subjects) do not understand the different forces (StuCtool) 59-The students (subjects) do not understand how to do calculations of levers and gradient (StuCtool) **66**-Most students (subjects) don't know how to plan OBE lessons (StuCtool) **68**-The students (subjects) do not understand "this portfolio thing" (StuCtool) and ask the researcher to explain 83-The students (subjects) do not understand hydraulic systems (StuCtool 97-The students (subjects) cannot explain why the ball bounces (StuCtool) 98-The students (subjects) cannot explain why the wax goes up and down (StuCtool) 100-The students (subjects) do not understand the notes on energy (StuCtool) and cannot make a summary for a poster
Science	28-The students (subjects) do not understand the concepts of surface area & acceleration (StuCtool) therefore cannot answer the questions or sketch the apparatus as required in the task (StuDOL) **37**-The students (subjects) have trouble preparing a science worksheet on the computer (StuCtool) 76-Students (subjects) are not happy about the integrated approach (StuCtool) because they are not sure which aspects will be in each exam paper (Lecrule)
Mathematics	21-The students (subjects) want to know if 'formulae F=MA' (StuCtool) is math or science and the lecturer says it is science (Lecrule) 31-The students (subjects) want to know if calculating area (StuCtool) is math or science and the lecturer says it can be math or science (Lecrule) 67-The students (subjects) want to know if VR and MA is science or math (StuCtool) because the lecturer does not make connection explicit (Lecrule) **70**-The students (subjects) do not remember which lesson plans (StuCtool) the lecturer is referring to that they must hand in (Lecrule) **72**-The students (subjects) think that the lecturer has not had time to mark lesson plans so that is why they have to mark them through peer assessment (StuCtool) **75**-The students (subjects) have a problem with compiling OBE lesson plans (StuCtool)
Education	**1**-The students (subjects) are not sure how to plan an OBE lesson (StuCtool)
LECTURERS' 'INTEGRATION' CONTRADICTIONS	
Technology	**48**-The lecturer (subject) refers to outcomes in lesson planning (LecCtool) but delivers a "traditional lesson" (LecDOL) **62**-The lecturer (subject) is confused about OBE terms (LecCtool) **63**-The lecturer (subject) is not sure of the type of Portfolio he wants the students to compile (LecCtool) **67**-The lecturer (subject) does not explain how to plan an OBE lesson (LecCtool) and tells the students to consult the Education lecturer **75**-The lecturer (subject) does not give assessment criteria (Lecrule) to students when he gives the portfolio assignment (LecDOL) **81**-The students (subjects) ask the lecturer for the assessment criteria (Lecrule) for the hydraulic model but the lecturer does not have it (LecDOL) **94**-The lecturer (subject) gives students assessment of OBE lesson in old style (Lecrule) that does not assess all aspects of the assignment, i.e. not aligned (LecCtool) **108**-The lecturer's (subject) assessment rubric (Lecrule) does not fit Part 2 of portfolio (LecCtool) **109**-The lecturer (subject) clarifies the portfolio (LecCtool) for the students but his understanding now has changed from his original presentation
Science	**62**-The students (subjects) are not happy about doing the "designer" task (LecCtool)
Mathematics	**58**-The lecturer (subject) introduces 'reflection' into the lecture session for the first time (LecCtool) without explaining the relevance of the strategy to the students **59**-The lecturer (subject) does not allow enough time (Lecrule) for the students to write down their thoughts or reflections (StuDOL) **79**-The lecturer (subject) implements a jigsaw (LecCtool) without the students being able to understand the notes **80**-The students (subjects) have to leave their jigsaw activity (StuDOL) to pay their fees (Lecrule)

Contradictions emerged as a result of the students' inability to fully grasp the concepts and terminology in the respective Activity Systems (mentioned in Section 8.1.1), which meant that they had difficulty applying their knowledge and understanding in the Activity Systems in different ways. Knowledge should not be confused with understanding since the former may be demonstrated through the regurgitation of 'facts,' whilst the latter is demonstrated when knowledge is applied in a new situation.

Firstly, contradictions occurred when the students could not apply their knowledge of scientific concepts in the Technology Activity System [see Technology contradictions 57, 58, 83 97, 98 and 100] and did not have adequate conceptual 'tools' to grasp the mathematical language when required to do calculations in the Technology Activity System [see Technology contradiction 59]. The following conversation illustrates this point. The conversation took place between three students who were grappling with calculating the 'gradient' of the constructed apparatus in the cross-curricular activity in Figure 8 [see Appendix V for the complete cross-curricular task]. While two of the students grappled with the problem, the third less confident student stayed silent during most of the conversation:

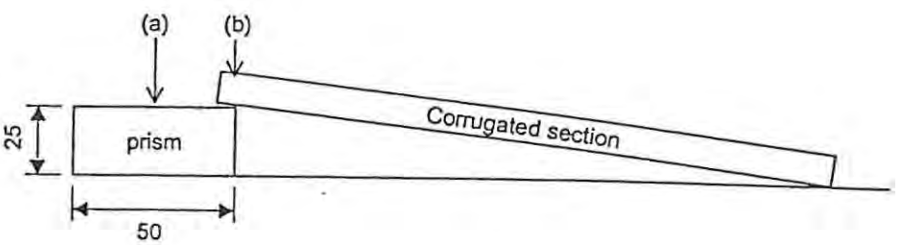


Figure 8. A sketch from the cross-curricular learning opportunity to introduce physics [Technology Worksheet, 15 December 1999]

Student 1:	Determine the gradient of the slope. The gradient ... it is the vertical height ... Was it HV? ... of the horizontal component into the vertical ... which one is the first one?
Student 2:	I think it is the horizontal ...
Student 1:	So it is the horizontal versus the vertical. So the horizontal is ...
Student 2:	We have to measure it ...
Student 1:	Where do we measure the horizontal?

Student 2:	I think it the horizontal is from here to here [indicating the length of the constructed corrugated section (b)] and the vertical height is this [indicating the side of the prism (a)] ...
Student 1:	[starts to measure the side of the sketch on the worksheet]
Student 2:	But, don't we have to measure it on the actual thing?
Student 1:	The actual thing? ... here? ... not on the paper? Do you mean this? [pointing to the constructed sections]
Student 2:	Listen, you must tell me ... I am asking ...
Student 1:	No, no ... you were here yesterday!
Student 2:	[laughs]
Student 1:	[measuring the horizontal on the constructed corrugated section (a)]. It is 245 mm ... [measuring the vertical height of the prism with the end of the ruler included in the measurement].
Student 2:	[observing Student 1's error] Lift the prism up ...
Student 1:	[lifting the prism up] ... So it is 45 mm ...
Student 2:	Where did you measure?
Student 1:	From here to here [indicating the bottom of the prism to the top of the constructed corrugated section]. I think it is correct ...
Student 3:	We must exclude the top part ...
Student 2:	O.K. So what was that one [measurement] then?
Student 1:	25 mm. So five into 25 mm is 5 times. Five into 245 mm is 49 ... right?
Student 2:	Well done!

Field notes Technology Module (15 December 1999)

The Technology learning area in Curriculum 2005 draws from Science and Mathematics, stressing what Olson (1997:384) refers to as the cognitive element of making. The DoE hoped that by associating Technology with Science and Mathematics, it would motivate learners to learn Science and Mathematics. Technology, as a 'practical capability', is associated with Science to bring together practical action with the development of knowledge and skills from these subjects (Black 1998:unpaged).

When the larger FDE Activity System was implemented, an attempt was made to integrate Science and Mathematics concepts into the Technology Activity System in practical tasks. Since each discipline has its own body of knowledge, it may have been difficult for the students (particularly those with a Mathematics and Science Grade 10 qualification) to develop their conceptual understanding of technological, scientific and mathematical concepts whilst carrying out the practical tasks in the larger FDE Activity System.

Scientific and mathematical concepts and skills need to be learned in a sequential manner to facilitate cognitive access (S.A. DoE 2000:40). Without sufficient grounding in these disciplines, the students may not have had the cognitive 'tools' to engage adequately with the technological, scientific and mathematical concepts. As a result, the students may have lacked the ability to link Technology to Science and Mathematics (S.A. DoE 1997h:26-28).

Secondly, whilst the students realised that the Technology, Science and Mathematics were separate disciplines they could not always discriminate between the concepts in each discipline [see Mathematics contradictions 21, 31, 67]. One student said in her portfolio: "Science, Math and Technology are intertwined that sometimes it's not easy to separate one from the other. However, this course has taught me that they are not the same" (FDE student portfolio 2000). The students' dilemma gave rise to a secondary contradiction in the Science Activity System since they were anxious about which concepts and terminology would be examined in the Science and Mathematics Modules in the final examination [see Science contradiction 76].

The Technology, Science and Mathematics Activity Systems within the larger FDE Activity System were meant to be closely integrated, however the integration was largely implicit, which may have contributed to the students' inadequate understanding of the relationship between Science and Mathematics and how Science and Mathematics were related to Technology. The contradictions suggest that the students may not have adequately developed conceptual 'tools' in Technology, Science and Mathematics, to be able to integrate the scientific and mathematical concepts into the Technology learning area to comply with Curriculum 2005 (S.A. DoE 1997h:28) and OBE (S.A. DoE 1997b:7) and to demonstrate the roles of a 'highly competent' learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22).

Thirdly, the students had difficulty comprehending certain terms that the lecturer assumed they knew and as a result the students could not proceed with the task. For example, the students grappled with the meaning of the terms 'corrugated' and 'perimeter' before attempting to calculate the 'surface area' and 'acceleration' in the same cross-curricular task mentioned earlier [see Science contradiction 28]. The following conversation that arose between three students in a group illustrates this contradiction:

Student 1:	Now what? Do we answer the questions?
Student 2:	Yeboo!
Student 1:	Now the first one says ... can you read it?
Student 2:	How long is the perimeter of the outer edge of the corrugated section?
Student 1:	Perimeter on the outer edge? ...
Student 2:	... of the corrugated section ...
Student 1:	Now if ... [pauses to look at the model]
Student 2:	What is the corrugated section?
Student 1:	Ya. [agreeing]
Student 3:	So, what are they asking there?
Student 1:	They are asking the length of this ... of this four sides. This side plus this side plus this side plus this side [indicating the length of the oblong at the highest point and across the corrugations to the other side].
Student 2:	Why do you think four sides? ... the outer edge? ... I don't know!
Student 3:	Or is it this ... this ... this ... this ... [indicating the top of the "M" side of the oblong].
Student 1:	... [pause] You know ... if ...
	The lecturer interrupts the groups ...
Student 3:	OK you were saying ...
Student 1:	Now if this is a rectangular ... if you want to calculate the perimeter of this ... now when you calculate the perimeter of this rectangle you say the perimeter is equal to ...
Student 2:	Length times breadth times width ...
Student 1:	We are going to say length plus breadth plus length plus breadth.
Student 3:	OK
Student 1:	Do you understand? That is for the perimeter. A shorter formula you can say length plus breadth times two. So that is why I have got this ... [hesitating] ... We have got to ask ... [the lecturer's name] because I am confused about this outer edge. What is the outer edge? Which one?
Student 2:	OK ... so if this [oblong] was flat instead of up and down ... then what would it be?
Student 1:	If it was like this [flattening out the middle section] then we are going to take this length plus this breadth plus this length plus this breadth. The four sides.
Student 3:	So, is that no the answer then?
Student 1:	Sorry?
Student 3:	Is that not the answer then?
Student 1:	... [laughs]
Student 2:	We want to be sure ...
	The student then calls the lecturer to help them.

Field notes Technology Module (15 December 1999)

The students' inadequate English language and cognitive development (as discussed previously in Section 8.1.1) may have played a role in the students' inability to understand the terms and concepts in the cross-curricular activity, resulting in an inadequate conceptual understanding in the Technology, Science and Mathematics Activity Systems.

Fourthly, contradictions also emerged when the students were unable to integrate their knowledge and understanding of OBE concepts and principles in all four Activity Systems to improve classroom practice, as suggested in educational policy (COTEP 1998 and S.A. Government Gazette 2000). Contradictions arose when students were unable to plan OBE lessons despite having attended the OBE lesson planning lecture session in the Education Activity System [see Technology contradiction 66, Science contradiction 37 and Mathematics contradictions 70 and 75]. A constraining factor in developing the students' conceptual understanding of OBE lesson planning may have been the fact that the OBE lesson planning lecture session took place in the first year of the FDE whilst the students were required to plan the Technology, Science and Mathematics lessons in the second year of the FDE.

Planning is a skill that requires forethought and since the students had an inadequate conceptual understanding of OBE lesson planning, the students may not be able to demonstrate this skill when implementing the role of interpreter and designer of learning programmes and materials (COTEP 1998:73-74 and S.A. Government Gazette 2000:16-17). The ability to plan in advance and thereby manage oneself responsibly and effectively is key to demonstrating this role (S.A. DoE 1997b:7). Mastery of planning will also be evident when the students are able to demonstrate the ability to lead, manage and administer their duties effectively in their work and home environment as required in COTEP (1998:75-76) and S.A. Government Gazette (2000:17-18).

Further contradictions emerged when the students did not adequately grasp the concept of OBE assessment in the Education Activity System and could not apply their knowledge in the Mathematics and Technology Activity Systems [see Mathematics contradiction 72 and Technology contradiction 68]. The integration or links between the four Activity Systems in respect of OBE were made more difficult for four reasons.

Firstly, the NGO lecturer was attempting to implement a formal approach to OBE, in response to emerging educational policy, for the first time [see Technology contradiction 48]. OBE was initially implemented 'informally' in the Technology Activity System:

> I am trying to develop within the programme a condition where the critical outcomes and specific outcomes for Technology Education are addressed. But I am doing it in a very informal way because this programme is not necessarily driven in class using the formal Department of Education outcomes-based approach. In fact I don't think any tertiary education institutions are doing it right now.
>
> Interview NGO lecturer (26 August 1999)

Whilst the NGO lecturer was positive about changing his practice to an outcomes-based approach, he grappled with implementing outcomes-based assessment in the Technology Activity System [see Technology contradictions 75, 81, 94 and 108]. When the NGO lecturer first introduced a portfolio as an assessment 'tool' in the Technology Activity System he had difficulty explaining how the portfolio could have a 'teaching', a 'best work' and a 'process' focus [see Technology contradiction 63]. Later, he added a 'learning' focus to the portfolio [see Technology contradiction 109], which may have contributed to the students' confusion regarding portfolio assessment.

Secondly, the Department of Education made the change to a formal OBE approach more difficult by the obscure OBE terminology adopted. Primary contradictions arose when the NGO lecturer, like many other educators, was confused by the array of OBE terminology [see Technology contradiction 62]. The NGO lecturer felt that "the Department has made a huge error in terms of the volume and reams of paper they have generated trying to explain how simple this is" (Interview NGO lecturer 26 August 1999).

Thirdly, the NGO lecturer did not always feel confident in implementing OBE and primary contradictions emerged when he suggested to the students that they consult the Education lecturer when planning the OBE lesson in the Technology and the Science Activity System [see Technology contradiction 67 and Science contradiction 62 respectively].

Fourthly, while the NGO lecturer tried to implement OBE strategies into his lecture sessions, these strategies were not always successful in developing the students' understanding [see Mathematics contradiction 58, 59, 79 and 80]. Since the exercises were not repeated, the students did not grasp the significance of the intervention nor could they practise implementing OBE strategies as the NGO lecturer and educational policy intended.

The shift in educational policy to comply with SAQA and the NQF meant a shift away from a content-driven model in COTEP (1994, 1996) to a competence-based model in COTEP (1998) and S.A. Government Gazette (2000). Since the larger FDE Activity System was conceptualised prior to the introduction of OBE, the FDE was based on a content-driven model and not on the competence model although the nature of Technology supports the latter model.

The difference between the 'object' of the larger FDE Activity System, which did not have an OBE focus, and educational policy (COTEP 1998 and S.A. Government Gazette 2000) may have contributed to the contradictions concerning OBE. The theoretical focus and poor integration of the Education Activity System with the Technology, Science and Mathematics Activity Systems may also have contributed to the students' inability to develop adequate OBE conceptual 'tools', resulting in the students not being able to demonstrate the role of interpreter and designer of learning programmes (COTEP 1998:73-74 and S.A. Government Gazette 2000:16-17), learning mediator (COTEP 1998:71-73 and S.A. Government Gazette 2000:15-16) and assessor (S.A. Government Gazette 2000:21)

Further contradictions emerged in the Technology and Mathematics Activity Systems arising from the students' under-preparedness with regard to physical tasks.

8.1.3 'Drawing and measuring skill' contradictions

The contradictions concerning the students' conceptual 'tools' relevant to drawing and measuring skills occurred in the Technology and Mathematics Activity Systems. Table 13 shows the contradictions that occurred in the respective Activity Systems.

Table 13. A description of the 'drawing and measuring skills' contradictions in the Technology and Mathematics Activity Systems

STUDENTS' 'DRAWING AND MEASURING SKILL' CONTRADICTIONS	
Activity System	**Description**
Technology	2-The students (subjects) do not know how to use pencil, ruler and colouring pens to draw accurately or colour in (StuCtool) 18-Some students (subjects) lack painting and décor skills (StuCtool) and do not make a product of the highest level of workmanship (Lecrule) 28-The students (subjects) do not have skills to make a full size copy of picture (StuCtool) 29-The students (subjects) do not know how to enlarge a picture by 2:1 (StuCtool) 34-Some students (subject) have difficulty changing 2 dim picture to 3 dim in icon task (StuCtool)
Mathematics	2-The students (subjects) have difficulty measuring accurately and cutting with knife on mat (StuCtool)

The students' fine motor co-ordination skills were not adequately developed and primary contradictions arose when basic skills like using a pencil, ruler, colouring pencils and drawing or colouring in accurately [see Technology contradiction 2], that most students' master early in their schooling, were learned for the first time in the Technology Activity System. One student expressed his joy at learning these basic skills for the first time:

> You know, it was for the first time in this Technology class that I learned to hold a pencil when you are drawing. You don't ... it must not be straight it must be slanting. How to hold a crayon? You don't press with a crayon ... just put it lightly and you add a little water to it and it makes a nice picture!
>
> Interview FDE student (28 August 1999)

Another student was at first perplexed at having to do basic drawing exercises in the Technology Activity System and wrote in his portfolio:

> When our educator gave us pictures to colour, I did not know the reason why he had to waste time by doing so because I thought I knew how to do the colouring and shading. To my surprise, I saw the difference after he had shown us how it was actually done. He showed us how to hand *[sic]* a pencil or crayon when shading or drawing. He taught us what type of lead pencil we must use for drawing and that pencils have different hardnesses depending on what you want to use it for ...
>
> FDE student portfolio (2000)

Other primary contradictions arose when more advanced drawing skills were also encountered for the first time in the Technology Activity System [see Technology contradictions 28, 29 and 34]. One student remarked on his shift in conceptual understanding as a result of participating in these practical activities:

> I was never faced with such activities during my education. Now I am learning the skill ... and it also widens your scope of thinking. You know. For instance today we were talking about the two dimensional and three dimensional ... I didn't know that my body is three dimensional. But through Technology it has shown me that my body is three dimensional ...
>
> Interview FDE student (28 August 1999)

A secondary contradiction arose in the Technology Activity System as a result of the students' inadequate drawing skills, which led to their inability to produce artifacts or products of a high level of workmanship [see Technology contradiction 18]. Workmanship is an important aspect of being a Technology learning area specialist. One of the students remarked on the importance of skills development in the Technology Activity System, when he said, "I have noticed with this Technology that it is skills based and that is what OBE is all about. You have to do things with your hands not just learn everything in your mind" (Interview with FDE student 31 July 1999).

The DoE's rationale for introducing Technology as a new learning area in Curriculum 2005 was *inter alia,* to develop the knowledge and skills necessary to design new technologies to improve the quality of peoples' lives (S.A. DoE 1997h:3). The DoE's approach has a 'skills' and 'social' perspective whereas Lewis (1996:48) proposes the former whilst Gentry and Csete (1991:25) favour the latter.

In addition to the contradictions in the Technology Activity System, primary contradictions occurred when the students were unable to measure accurately in the Mathematics Activity System [see Mathematics contradiction 2]. The NGO lecturer recalled his experience of a student's ability to measure a tangram puzzle:

> The idea of measuring length ... You know that bit on the end of the ruler... that's often the problem. I had a student ... [demonstrating on a ruler how the student measured] ... Notice what I am doing. I'm measuring backwards. She measured 190 mm when in fact the measurement should have been 11 cm ...
>
> Interview NGO Lecturer (17 March 2000)

The students' demonstrated the use of 'tools' like pens, pencils, rulers, paint and crayons at the lower level of conscious 'operations' while as a Technology learning area specialist they were expected to demonstrate skills at the middle level of goal directed 'action' and the upper level of 'activity' when carrying out these tasks. Internalising 'new' knowledge and skills takes time as the individual moves from the level of 'operations' to 'actions' to 'activity' (Leont'ev 1978) or from being a 'novice' to being an 'expert' (Dreyfus and Dreyfus, as cited in Engestrom 1987:216). Whether the individual learns from experience will depend on the individual 'schemata' from previous experiences, according to Brehmer, as cited in Engestrom (1987:218). As was evident from the students' work not all the students had the 'appropriate schemata' to draw from and therefore needed additional time in which to develop their skills from which they would be able to draw in the future.

Whilst OBE requires flexible timeframes that allow students to work at their own pace (S.A. DoE 1997b:7) this was however not possible given the part-time nature of the FDE. The students therefore had a limited time within which to develop their skills and demonstrate their competence in drawing. The students' inadequate basic fine-motor co-ordination skills may have contributed to some of the students not being able to demonstrate the mastery of the technological capabilities like drawing that are integral to the students' ability to demonstrate the role of Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22).

Arising from the students' under-preparedness with regards to conceptual understanding and poor measuring and drawing skills, was the students' inability to apply their knowledge and skills in the steps in the technological process in the Technology Activity System.

8.1.4 'The technological process' contradictions

The contradictions that emerged within the Technology Activity System concerning the students' conceptual 'tools' relating to the technological process are shown in Table 14.

Table 14. **A description of the 'technological process' contradictions in the Technology Activity System**

STUDENTS' 'TECHNOLOGICAL PROCESS' CONTRADICTIONS	
Activity System	**Description**
Technology	40-The students (subjects) do not know how to apply the TE process when designing the gadget (StuCtool) 85-The students (subjects) assemble hydraulic model incorrectly (StuCtool) 101-The students (subjects) do not know how to assemble their steam engines (StuCtool) 104-The lecturer (subject) tells the students that the balancing toy assignments show no evidence of research (StuCtool) 105-The lecturer (subject) tells the students that the balancing toy assignments show repetition of information under different headings in the TE process (StuCtool) 106-The students (subjects) are confused about concepts of working drawings (StuCtool) 107-The students (subjects) are confused about concepts of design, portfolio (StuCtool)
LECTURERS' 'TECHNOLOGICAL PROCESS' CONTRADICTIONS	
Technology	7-The lecturer (subject) changes the task from 'designing' their own box (LecCtool) and gives students a design to measure and cut card to prescribed measurements (LecDOL) 41-The lecturer (subject) wants the students to design a 'gadget' to remove the toxic waste (LecCtool) but students copy and adjust design of 'gadget' (StuDOL) from the notes 72-The lecturer (subject) wants the students to 'design' (LecCtool) but he gives the students a design (LecDOL)

Primary contradictions manifest in the Technology Activity System resulting from the students' inadequate grasp of the concepts and terminology in the Technology Activity System (see section 8.1.1). The students were unable to apply their knowledge and understanding of concepts that were integral to the steps in the technological process and fundamental to acquiring technological literacy in the Technology Activity System [see Technology contradictions 104, 106 and 107]. The technological process is a complex process that requires both conceptual and physical skills to identify the need, interpret information to find possible solutions within specific parameters, and requires reflexive skills to refine and improve initial ideas. The students found demonstrating the steps in the technological process challenging given their inadequate conceptual development (see section 8.1.1) and basic level of drawing and measuring skills (see section 8.1.3).

Contradictions occurred in the Technology Activity System when the students experienced problems applying the steps in the technological process in practical situations due to their inadequate conceptual and fine motor co-ordination development. A primary contradiction arose when the students were required to make a toxic waste removal gadget [see Technology contradiction 40] in a design task involving mechanisms. One student said:

> Yesterday's project was very difficult ... What I noticed about it was that when we were told to make that ... object to lift that drum of oil from that place ... What we did as students was ... to go straight to make the project itself. The prototype. But, according to ... [lecturer] now he said that there are those steps ... the situation, you analyse the situation, the brief and so on. What we did yesterday ... we just went straight to make the prototype you know. I am sure it is that some of us are used to make these things ... it is like this Technology we associate with these hand work ... If I had to make a wire car I just make the wire car. I don't have to follow the steps ... I know what I am going to do ... so that is what we did yesterday.
>
> Interview FDE student (28 August 1999)

Another aspect of 'making' that some students had difficulty with was assembling the models [see Technology contradictions 85 and 101]. The fact that the students lacked confidence in doing tasks for the first time may have contributed to these contradictions arising. One student said:

> When you are shown a completed project you become very frustrated. Having questions like 'Am I going to do this? How?' The lecturer shows you ... You do it, also not believing that you could cope to do it. When you do it you find its interesting and very exciting that you did it yourself.
>
> Interview FDE student (3 September 2000)

The students believed that through practice they would grasp the skills required to successfully complete a Technology task. One student wrote in her portfolio, "The problem I had was in preparing drawings, making [a] prototype and making [a] design. I noticed that the problem I have is due to lack of practice" (FDE student portfolio 2000). Another student wrote:

> This course needs time because most of us are new to it and I can see that this course needs somebody who is gifted in art and in creativity therefore those who are less gifted in designing needs a lot of time.
>
> Evaluation of Technology Module (6 November 2000)

The students' assumption that given enough time and practice they could improve their skills is confirmed by Dreyfus and Dreyfus, as cited in Engeström (1987:216) but is refuted by Brehmer, as cited in Engeström (1987:218). Brehmer argues that practice is not enough to improve one's skills. Rather, it is one's ability to use the information or 'schemata' from past experience that will enable one to learn to do the task. Part of developing one's skill is reflecting on one's work which does not come naturally. Whilst the eleven steps in the technological process in the Technological Activity System is an external means for reflection, it requires interaction during shared activities for learning to take place. To promote learning the lecturer needed to create different types of shared activities to promote reflection.

The Senior Phase document on educational policy refers to the technological process as "the cycle of investigating problems, needs and wants and the designing, developing and evaluating of solutions in the form of products and systems" (S.A. DoE 1997g:8). A key aspect of 'design' is the ability to communicate effectively using visual modes or oral and/or written presentation (S.A. DoE 1997b:16) and 'design' is one of the important steps in the technological process that needed to be mastered if the students were to be re-educated as Technology learning area specialists.

The implementation of Technology in the larger FDE Activity System did not wholly reflect the process of designing, developing and evaluating solutions (S.A. DoE 1997g:8). The implementation of Technology reflected a 'design, make and evaluate' focus where, due to time constraints, the students were given pre-prepared 'designs' to 'make' [see Technology contradiction 7, 41 and 72]. The NGO lecturer, through the summative assessment, carried out the 'evaluation' of the product. By giving the students existing 'designs', the NGO lecturer adopted a 'technical' approach to Technology that emphasised craft skills (De Vries, cited in Black 1998:unpaged). Whilst this was an active learning approach in line with OBE principles, it did not reflect the theory that people learn by 'doing,' since the 'doing' aspect in Technology is 'designing' and communicating information graphically (Shield 1996:unpaged). The students thus did not gain the necessary experience in 'design' as Technology learning area specialists who are "highly competent in the knowledge, skills, values and principles, methods and procedures relevant to the specialism" (COTEP 1998:88). The NGO lecturer explained his actions:

In reality proper Technology Education practice requires that one is given an opportunity to develop a solution to a problem over a period of time. This problem is reached by moving steadily through stages in the process we call the technological process. And typically I'm using the eleven-stage process right now. But the reality is if we were to do that here we'd get through very, very little because most of the work would have to be done at home. And because we have one-month slots it could take three of four sessions to get through a project ... which is a nightmare, it really is.

Interview NGO lecturer (17 March 2000)

In addition, the students were not able to 'design' an original artifact to meet the design brief [see Appendix W for the 'balancing toy' design brief and assessment criteria]. As a result of the inadequate 'design' skills the students could not competently illustrate their 'designs' in their 'working drawings' [see Technology contradiction 105] in the 'balancing toy' assignment [see Appendix X for a student's 'working drawings' in the balancing toy assignment].

Figure 9 illustrates the inappropriate 'design' of a student's balancing toy made from purchased mass produced frogs, which does not illustrate the principle of balance since it has a fixed centre and the weights (frogs) at either end of the 'lever' are fixed.

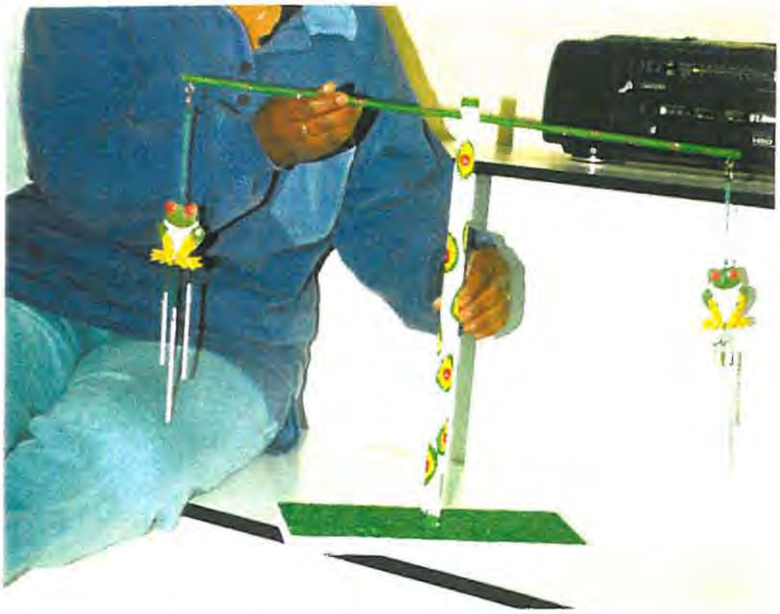


Figure 9. An example of an inappropriate 'balancing toy' design

Whilst the NGO lecturer expected the students to implement the eleven steps in the technological process in written assignments he did not clearly articulate how the practical activities fitted into the eleven steps in the technological process. As a result, in their written assignments, the students repeated information in the different steps in the technological process which suggested that the students may not have sufficiently developed the cognitive processes and reflexive skills to use the technological process as a 'tool' to solve technological problems [see Appendix Y for an example of the students' understanding of the steps in the technological process].

As a result of an inadequate understanding of the steps in the technological process the students may not have grasped the concepts "fundamental to the acquisition of technological literacy" according to the S.A. DoE (1997g:8). Without adequate comprehension of the steps in the technological process, which is a key feature in Technology in Curriculum 2005, the students may not be able to demonstrate the competence required of a Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22), learning mediator (COTEP 1998:71-73 and S.A. Government Gazette 2000:15-16), interpreter and designer of learning programmes (COTEP 1998:73-74 and S.A. Government Gazette 2000:16-17) and assessor (S.A. Government Gazette 2000:21).

Problem-solving is one of the key requirements of employers for workers to adapt in a rapidly changing technological society according to Resnick, as cited in Biehler and Snowman (1991:424). Without adequate knowledge and skills to solve not only technological problems using the steps in the technological process, the students may not be in a position to fulfill the aim of educational policy to redress apartheid inequalities and develop a skilled and productive South African workforce that is able to compete in the world and global markets.

The 'making' focus in the Technology Activity System was largely devoid of social and environmental concerns (Gentry and Csete 1991:25) - where a reflexivity exists between the social context and problem-solving, and did not reflect a cognitive emphasis on problem-solving (Olson 1997:384). Instead, the emphasis on 'making' reflected the development of 'practical capability' that brought together practical actions with the development and use of knowledge and skills from subjects like Mathematics and Science as suggested by Black (1998:unpaged). The implementation of a 'making' focus without the accompanying emphasis on problem-solving was contrary to the 'object' of the FDE Activity System that the lecturer intended to implement (see Chapter 7 section 7.1)

The approach adopted was thus a narrow skills-based interpretation of technological literacy as opposed to the problem-solving and socio-cultural perspective suggested in educational policy (S.A. DoE 1997h:14). Without the socio-cultural perspective the students may not be able to demonstrate the critical outcome to show an awareness of cultural sensitivity in their role as citizen and community (COTEP 1998:76-78 and S.A. Government Gazette 2000:18-20). The students also did not practice identifying and solving problems using creative and critical thinking which is one of the critical cross-field outcomes (S.A. DoE 1997b:16) that students need to demonstrate whilst applying the technological process. Other critical outcomes that the students may not be able to demonstrate is the need to understand the world as a set of related systems where problem-solving contexts do not exist in isolation (S.A. DoE 1997b:16). To this end the students may also not be able to demonstrate "a critical, committed and ethical attitude towards developing a sense of respect and responsibility towards others" (S.A. Government Gazette 2000:14) through the application of the technological process.

Whilst the steps in the technological process, as the preferred method of solving technological problems in the Technology Activity System, gave rise to contradictions, so too did problem solving of a mathematical nature give rise to contradictions in the Mathematics and Science Activity Systems.

8.1.5 'Problem-solving' contradictions

The contradictions that arose within the Mathematics and Science Activity Systems concerning the students' conceptual 'tools' regarding problem solving are shown in Table 15.

Table 15. A description of the 'problem solving' contradictions in the Mathematics and Science Activity Systems

STUDENTS' 'PROBLEM SOLVING' CONTRADICTIONS	
Activity System	**Description**
Mathematics	9-The students (subjects) have difficulty solving the tangram puzzles (StuCtool) 16-The students (subjects) do not know how to find the common denominator (StuCtool) 17-The students (subjects) do not know how to do fraction examples (StuCtool) 33-Some students (subjects) do not know how to calculate area and do not write the m2 in answer (StuCtool) 49-The students (subjects) confuse 'shapes' with 'patterns' in the garden exercise (StuCtool) 53-The students (subjects) find it difficult to do a 24 piece puzzle (StuCtool) 60-Some students (subjects) do not find the sequence to solve the problem/puzzle (StuCtool) 63-Some students (subjects) have difficulty doing VR, MA and η calculations (StuCtool)
Science	33-The students (subjects) do not know how to do the moment and couple calculations (StuCtool) although this is revision from the Technology module 42-The students (subjects) do not know how to do the calculations for VR and MA (StuCtool)

The fact that many of the students had very little prior knowledge of Mathematics meant that those students found solving mathematical problems challenging [see Mathematics contradictions 16, 17, 33 and 63 and Science contradictions 33 and 42]. For example, in one lecture session the NGO lecturer explained the 'short' method of adding fractions and then discussed the 'long method' if the students could not find the common denominator. The following conversations took place between two students who were trying to do an example using their 'own' method, which resulted in confusion when they realised that their method was different to what the lecturer had explained.

Example **2/3 +1/6**

Solution: (Short method) $\frac{4+1}{6} = \frac{5}{6}$ **OR** **(Long method)** $\frac{12+3}{18} = \frac{15}{18} = \frac{5}{6}$

(Students' method) $\frac{8+2}{12} = \frac{10}{12} = \frac{5}{6}$

Student 1: We must find the common denominator ... or else serious disaster ...

Student 2: There is this ... which he said ... you remember he said you must ...

Student 1: ... look for the commonest ... lowest common ...

Student 2: It is 12

Student 1: Ya [agreeing] It is 12. Then ... into 12 goes 1 ... 1 times 1 is ... no ...

Student 2: No that is first ... Start here [pointing to the 2/3]

Student 1: The lowest common denominator is 12 neh?

Student 2:	Ya [agreeing]
Student 1:	Then 12 into ...
Student 2:	You should have started by saying ... 3 times 4 neh?
Student 1:	Ya [agreeing]
Student 1:	Which is twelve and then we say 3 goes into 12 ... 4 times ...
Student 2:	Ya [agreeing] And 4 times 2 ... that gives you 8
Student 1:	3 multiplied by 4 gives 12
Student 2:	12? [confused]
Student 1:	And again here ... 4 goes into 12 ... 3 times and then we say 4 multiplied by 3 and 1 multiplied by 3 ... and then we get the answers. Then we total up these two ... then ... that's what I was saying here [turning the page]. If then we use the long method we are going to say 3 multiplied by 6 ... which is?
Student 2:	18. O.K.
Student 1:	And then say 3 multiplied by 18 again ... we are going to do that.
Student 2:	Naah. It is supposed to be six. Three multiplied by 18 ... how many times does ... we have to divide 18 by 3 each time. It is supposed to be like that ... because ...
Student 1:	No. We are going to say 3 goes into 18 ... six times. Then we say 3 times 6 ...
Student 2:	It is 18. Yakona!
Student 1:	Mmm [confused]
Student 2:	Why is it 18?
Student 1:	Why? Take this example ...
	The students then try to do the next example ...

Field Notes Mathematics Module (27 August 1999)

Since knowledge is constructed from the learner's experience, the fact that the students tried to use their 'own' method to solve the problem indicated that they were applying tacit mathematical rules that they had previously learned. Whilst it is important to provide "regulative clues and other instructional prompts" for weaker students it is also important for lecturers to provide learning opportunities that allows the learner to develop and internalise knowledge to engage in autonomous problem-solving (Craig and Winter 1990:59). The NGO lecturer's approach to teaching mathematics relied on "reproductive thinking" (Mayer 1992:42) since the lecturer's teaching strategy involved the students following a 'tried and tested' recipe of steps (see Chapter 10 section 10.2.1).

In addition to well-structured problems, primary contradictions also arose when the students' attempted to solve puzzles [see Mathematics contradictions 9, 49 and 60]. Puzzles are different from ill-structured problems. Puzzles have one correct solution, which is achieved through using a specific decision-making procedure whilst ill-structured problems do not have an absolute solution (Craig and Winter 1990:63). Puzzles are considered to be well-structured problems (Kitchener 1983:224). The lecturer explained how one group of students had problems with finding the pattern in Pascal's triangle:

> There was one table where there were problems and they missed the repeated pattern ... They had missed it completely ... They had missed the pattern and it didn't matter which two horizontal blocks we were talking about ... their sum was added to the diagonal top. And what they'd actually done was ... they'd simply copied a value repeatedly down ... If the number was 13 they just wrote down 13 ... and 13 ... and 13... and 13 ... And I said but hang on. 13 plus 13 does not give me 13. Or 13 plus 6 does not give me 13. Anyway we fixed that up ...
>
> Interview NGO lecturer (17 March 2000)

In addition, the weaker students had difficulty completing a 24-piece puzzle since they had never completed a puzzle before [see Mathematics contradiction 53] and one of the student said, "We didn't know where to start!" (Interview FDE student 14 May 2000). The weaker student's response confirms Wertheimer's findings that students who learned by 'understanding' were able to transfer their learning to new situations whereas the students who learned in a mechanical way (recipe method) "usually said 'We haven't had this yet'" when asked to solve unusual problems (Wertheimer, as cited in Mayer 1992:43).

Whilst the NGO lecturer intended to develop the students' core mathematical skills (see Chapter 7 section 7.1), he concentrated on developing well-structured problem-solving skills that had one 'correct' solution, and not ill-structured problems with multiple solutions. Since ill-structured problems are the types of problems in 'real life' situations, this approach was counter-productive to developing problem-solving skills in a technological environment where ill-structured problems are likely to be encountered. Ill-structured problems require students to engage in 'formal operations' or logical, abstract thinking, which is essential in mathematics and complex problem solving contexts (Piaget 1971). Since the students were not encouraged to develop these skills they may not be able to demonstrate the critical outcomes like being able to solve problems, understand problem solving in different contexts, collect and analyse data and the role of interpreter and designer of learning programmes (COTEP 1998:73-74 and S.A. Government Gazette 2000:16-17). In addition, without adequate problem solving skills the students may not be able to live up to the expectations of educational policy to develop citizens that are able to adapt to a rapidly changing technological world to enhance the capacity of the South African economy.

Contradictions also emerged in the Technology and Education Activity Systems concerning academic writing and research.

8.1.6 'Academic writing and research skill' contradictions

Contradictions concerning the students' and the lecturers' conceptual 'tools' with regards to academic writing and research emerged in the Technology and Education Activity Systems, which are shown in Table 16. The contradictions in this section are shown in bold since they are tertiary contradictions that resulted from a 'culturally more advanced object' namely, academic writing and research, being introduced into the Technology and Education Activity Systems.

Table 16. A description of the 'academic writing and research skills' contradictions in the Technology and Education Activity Systems

STUDENTS' 'ACADEMIC WRITING & RESEARCH SKILL' CONTRADICTIONS	
Activity System	**Description**
Technology	**45**-Some students (subjects) use inappropriate academic writing conventions (StuCtool) **46**-Some students (subjects) have problems with referencing (StuCtool) in library task **64**-The students (subjects) do not understand the difference between bibliography and reference (StuCtool)
Education	**46**-The students (subjects) did not understand what was required in mini management assignment (StuCtool) **47**-The students (subjects) did not understand what was required in the mini research assignment (StuCtool)
LECTURERS' 'ACADEMIC WRITING & RESEARCH SKILL' CONTRADICTIONS	
Technology	**65**-The lecturer (subject) does not explain the difference between bibliography and reference (LecCtool) and tells the students to consult the U ADC
Education	**34**The lecturer (subject) wanted to scaffold assignment (LecCtool) but not enough time between lectures for feedback and redrafting (Lecrule) **38**-The lecturer (subject) urges the students to get ADC help, however the lecturer is not aware that he needs to work with the ADC (LecCtool) prior to giving the assignment **51**-The lecturer (subject) has to mark mini research assignment (LecCtool) with open assessment criteria (Lecrule)

Given the dire lack of infrastructure and facilities like libraries and resource centres in most schools in the Eastern Cape Province it is not surprising that the students had very little experience of using these facilities. Contradictions arose in the Technology Activity System when the students had difficulties with referencing [see Technology contradictions 46 and 64], the conventions of academic writing and the requirements for doing 'research' [see Technology contradiction 45]. See Appendix Z for an example of a list of references with incorrect conventions and inappropriate sources such as 'Drum' and 'Your family'.

The NGO lecturer anticipated that the students would have problems with academic writing and research and said "I have learned that often things that I have taken for granted are often not the case. I have learned that my students have not had much library experience for example, and are not aware of how to do proper 'research'" (Interview NGO lecturer 26 August 1999). However, when the students asked about doing 'research' and the difference between 'bibliography' and 'reference' in the Technology Activity System, the NGO lecturer suggested that the students consult the staff in the Academic Development Centre (ADC) at the University campus in City B [see Technology contradiction 65].

A similar contradiction arose in the Education Activity System when the intended 'scaffolding' of the mini-research assignment did not materialise [see Education contradictions 46 and 47] and the Education lecturer urged the students to consult the ADC staff for assistance with their mini-research assignments [see Education contradiction 38]. Scaffolding is a strategy used to assist 'novices' to perform at a higher level (Vygotsky 1978) through a process of dividing a task into smaller tasks that demand progressively more cognitively advanced writing, whilst providing decreasing support as the student takes on more responsibility for the smaller tasks. The students were afraid that without the Education lecturer's support they would not be successful in the assignment [see Appendix AA for an example of a student's assignment]. One of the students said:

> I don't like the idea of failing an assignment. We must be given marks for the effort taken to write it. Nobody must fail an assignment taking into consideration that everybody's thoughts are okay.
>
> Evaluation of Education Module (5 November 2000)

The students' fears did not materialise despite the fact that there was not enough time between lecture sessions for feedback and redrafting of their mini-assignments [see

Education contradiction 34]. The Education lecturer attempted to resolve the contradiction by discussing the assignments with the students and distributing a 'memo' to give the students additional guidance before marking the mini-research assignments using 'open' assessment criteria [see Education contradiction 51]. See Appendix BB for mini-research assignment and assessment criteria.

Whilst the development of academic writing and research skills was important for the students who wished to enrol for further studies like a B. Ed (Honours) degree, it was not articulated by the NGO lecturer as an 'object' in the larger FDE Activity system nor was it reflected in the co-constructed Education curriculum. This may have contributed to the contradictions emerging in the Technology and Education Activity Systems. Writing requires 'higher order' thinking skills, according to Vygotsky (1978), that require the writer to make her thinking explicit by using language symbols more deliberately. Acquiring academic writing and research skills takes time since the students have to engage in a process of acquiring a new set of conventions that are specific to each discipline by participating in "various cultural acts of academia, such as attending lectures, taking notes, reading academic texts, writing essays, and entering into a dialogue with lecturers and fellow learners about the content and structures of these cultural acts" (Vorster 1999:24). Since the students may have had language difficulties, this may have constrained the students' ability to develop academic writing and research skills. The students' inability to access the University library facilities due to administrative problems (see Chapter 9 section 9.1) may also have constrained the students' ability to develop academic and research writing skills.

Acquiring academic writing skills was necessary to fulfil the larger FDE Activity System requirement to carry out basic research assignments in the respective Activity Systems and to demonstrate the role of scholar, researcher and lifelong learner (COTEP 1998:78-79 and S.A. Government Gazette 2000:20-21). Without adequate academic writing and research skills the students may not be able to demonstrate critical outcomes like communicating effectively and collecting, analysing and evaluating data (S.A. DoE 1997b:16).

Contradictions also occurred in all four Activity Systems concerning equipment 'tools' used by the 'subjects' to mediate their actions and activities in meeting the 'object' of the larger FDE Activity System.

8.2 The students' equipment 'tool' contradictions

The equipment 'tool' contradictions *mainly* concerned the students' actions in relation to the 'object' in all four of the Activity Systems as shown in Table 17.

Table 17. A description of the equipment 'tool' contradictions in all four Activity Systems

STUDENTS' EQUIPMENT 'TOOL' CONTRADICTIONS	
Activity System	**Description**
Technology	4-The students (subjects) do not have cutting mats and knives to use (StuEtool) 5-The students (subjects) without cutting mats and knives (StuEtool) share with their peers (StuDOL) 26-The students (subjects) do not have pictures for the icon task (StuEtool) 114-The students (subjects) do not have 'face plates' for the electricity task (StuEtool) 115-The students (subjects) without 'face plates' (StuEtool) make them during the lecture session (Lecrule)
Science	6-The students (subjects) do not have science kits and notes to use (StuEtool) 44-The students (subjects) do not have calculators and cannot do the task (StuEtool)' 46-The students (subjects) do not have calculators (StuEtool) and cannot do the calculations (StuDOL) 47-The students (subjects) do not know how to use their calculators (StuCtool) 50-The students (subjects) do not have textbooks to use (StuEtool) 51-The students (subjects) do not have textbooks (StuEtool) and cannot do examples (StuDOL)
Mathematics	4-The students (subjects) do not have cutting mats and knives to use in class (StuEtool) 5-The students (subjects) do not have cutting mats (StuEtool) and have to share with peers (StuDOL) 42-The students (subjects) do not have calculators (StuEtool) 43-The students (subjects) without calculators (StuEtool) share equipment with their peers (StuDOL) 45-The students (subjects) do not have math equipment to use (StuEtool) 46-The students (subjects) without math equipment (StuEtool) share instruments with their peers (StuDOL) 47-The students (subjects) do not know how to use their calculators (StuCtool) 62-The students (subjects) without math sets (StuEtool) use coins or draw diagrams in freehand (Lecrule)
Education	11-The students (subjects) do not bring their journals to the lecture session (StuEtool) and have to write on paper 36-The students (subjects) do not bring textbook to class (StuEtool) 37-The students (subjects) without textbooks (StuEtool) have to share with their peers (StuDOL)

The students were supplied with all the equipment 'tools' that they needed during the lecture sessions in all four of the Activity Systems, except equipment 'tools' like stationery and a scientific calculator which the students were required to provide. Contradictions emerged when the students did not bring the equipment that they had been given and/or did not bring the equipment that they were required to provide to the lecture sessions [see

Technology contradictions 4, 5, 26, 114 and 115, Science contradictions 6, 44, 46, 50 and 51, Mathematics contradictions 4, 5, 42, 43, 45, 46 and 62 and Education contradictions 11, 36 and 37]. The students who did not bring their equipment shared with their peers which meant that the students without equipment had to wait while their peers used the equipment, which contributed to the students not being able to complete the tasks in the available lecture time. It was also difficult for the lecturers to facilitate a learning opportunity when everyone was expected to have their own equipment. As a result the flow of the lecture session was disrupted:

> But where it falls down is when you're trying to work to time and you have four people sharing a ruler and three people with a pencil and two people with half a pen and an exercise which should take minutes takes hours. And because two of us are not actually participating because we are waiting for a ruler for example, it generates an opportunity for conversation and that breaks my heart... I don't understand it.
>
> Interview NGO lecturer (17 March 2000)

Adverse socio-economic conditions and a culture of 'entitlement' may have constrained the students' ability to manage equipment that they had not previously had access to and therefore never learned to manage. One of the students explained how his view had changed:

> We expect the government or whoever is involved to bring something for us. But now seemingly we are not worried ... if you get some material ... you can make your OWN teaching aids. So I am not looking at things as the way it was.
>
> Interview with FDE student (26 June 2000)

Equipment 'tools' in the larger FDE Activity System may be considered 'mediators' since they facilitate the development of certain behaviour (Bodrova and Leong 1996:69). Unfortunately, without the necessary equipment to act as a 'mediator', the students' may have contributed to their inability to develop the conceptual and physical skills needed to demonstrate the role of Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22).

Whilst the students may have brought equipment like scientific calculators to the lecture sessions, they did not know how to use them, resulting in their inability to do calculations [see Mathematics contradictions 47 and Science contradictions 47]. Merely having the equipment 'tools' in the lecture session was not enough to ensure that the 'tools' mediated the students' learning. Conceptual 'tools' are paramount since mediators only become mental 'tools' when they are incorporated into one's activity and for mediators to be effective, they must be used by the students to direct their actions (Bodrova and Leong 1996:83). Failure by the students to consider the equipment as an essential part of their learning, may have meant that they were not able to demonstrate the role of learning mediator (COTEP 1998:71-73 and S.A. Government Gazette 2000:15-16), interpreter and designer of learning programmes (COTEP 1998:73-74 and S.A. Government Gazette 2000:16-17) and leader, administrator and manager (COTEP 1998:75-76 and S.A. Government Gazette 2000:17-18).

The contradictions concerning 'tools' in the four Activity Systems have been dealt with in this chapter. The next chapter will elaborate on the 'rule' contradictions in the larger FDE Activity System.

Chapter 9 Findings and Discussion – The 'rule' element

The contradictions found within the 'rule' element in the larger FDE Activity System across all four Activity Systems will be presented and discussed in this chapter.

The 'rule' element refers to the explicit and implicit regulations, norms and conventions that constrain or enable the lecturers' and students' actions and interventions within the larger FDE Activity System. Contradictions arose in most cases when the students did not adhere to the organisational 'rules', namely, institutional and lecture 'rules', however, where the lecturers' actions may have contributed to the contravention of the 'rules', these contradictions are documented. Contradictions emerged across all four Activity Systems that concerned institutional and lecturer 'rules'.

9.1 Institutional 'rule' contradictions

The Memorandum of Agreement (1996) between the NGO branch in City B and the University in City A (discussed in Chapter 3), provided the boundary conditions within which the larger FDE Activity System was implemented at institutional level. The institutional 'rules' framed the teaching and learning contexts in the four Activity Systems and constrained the actions of the lecturers and the students. The institutional 'rule' contradictions are listed in Table 18.

Table 18. A description of the institutional 'rule' contradictions in all four Activity Systems

INSTITUTIONAL 'RULE' CONTRADICTIONS	
Activity System	**Description**
Technology	43-The students (subjects) do not pay (StuDOL) their tuition fees (Urule) 44-Some of the students (subjects) cannot get into U (StuDOL) because they do not have student cards (Utool) 50-The lecturer (subject) uses lecture time (Utool) to collect student fees (LecDOL) 60-Some students (subjects) are not registered (Urule) due to U administration problems (UDOL) 77-The students (subjects) are not fulfilling the DP requirement (Urule) which is 80% attendance (StuDOL) and this is now problematic for some students, hence the letter from FDE co-ordinator stating DP policy 118-The students (subjects) still have not paid fees (StuDOL) and the lecturer threatens them with legal action (NGOComm)
Mathematics	14-The lecturer (subject) uses lecture time (Utool) to collect student fees (LecDOL) 20-The lecturer (subject) uses science class time (Utool) to complete the math lesson (Lecrule)
Education	6-The 300 contact hours were not met (Urule) because of late start due to delayed registration (Utool.) 7-The students (subjects) did not know which venue to go to for the Education lecture (Utool) and class starts late (Lecrule) 19-The lecturer (subject) as the FDE facilitator uses lecture time (Utool) to sort out administrative problems (LecDOL) 28-The students (subjects) do not know where to go to write the test (StuDOL) because of changes of venue (Utool) 42-The students (subjects) are issued with temporary student cards (Utool) to get into the venue because U changed security system (Urule) 45-The students (subjects) are given a warning that anyone with less than 80% attendance (StuDOL) will not write exam (Urule) 49-The students (subjects) did not know which venue to go to (StuDOL) and they arrive late for the lecture session (Lecrule)

According to the agreement between the NGO branch in City B and the University in City A, the larger FDE Activity System would be administered by the University in City A and students would be required to register with the University in accordance with University Policy (University Calendar 1999a:236-248). Due to administrative problems, secondary contradictions emerged when students were not registered for the FDE despite the students paying their fees and completing the necessary forms [see Technology contradiction 60]. The delay in registration created problems for the students leading to further contradictions concerning four issues.

Firstly, the students could not obtain their student cards without being registered and without their student cards, were not able to gain access to the University campus in City B [see Technology contradiction 44 and Education contradiction 42]. The FDE co-ordinator resolved these contradictions by arranging temporary student cards for the students. While the students did not have access to the University in City B, they could not use the library and computer facilities on the campus, which may have constrained their ability to conduct 'research' and develop academic writing and research skills (discussed in Chapter 8 section 8.1.6).

Secondly, administrative problems impacted on the teaching and learning activities that resulted in lecture time being lost. Secondary contradictions emerged when the Education lecturer/FDE co-ordinator used lecture time to resolve the administrative problems in the Education Activity System issues [see Education contradiction 19].

Lecture time was further eroded when the examination at the end of the first year was postponed from December 1999 to February 2000 and lecture sessions in the second year only commenced in May 2000 and not in February as anticipated [see Education contradiction 6]. This put additional pressure on all of the lecturers to complete the University FDE syllabus (1998), and the students to develop the conceptual and physical skills required in a shorter period of time than stipulated in educational policy (COTEP 1996:119).

Lecture time was also lost when the students were required to pay their tuition fees to the NGO branch, as stated in the agreement between the NGO branch in City B and the University in City A. Since the NGO lecturer only interacted with the students when they attended scheduled lecture sessions at the end of each month and during the school vacations, he used lecture time to collect students' fees [see Technology contradiction 50 and Mathematics contradiction 14 and 20]. As a result additional pressure was put on the NGO lecturer and the students to complete tasks and develop the conceptual and physical skills required in the Technology, Science and Mathematics Activity Systems. The reduction of contact hours in the larger FDE Activity System, may have contributed to the students' inadequate development of skills to demonstrate the role of Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22).

Thirdly, tensions surfaced between the NGO lecturer and the students when some of the students did not fulfil their obligations to pay their fees [see Technology contradiction 43]. By not paying their fees, these students contributed to the administrative problems concerning registration since the students could not be registered without a minimum initial payment being made. Since the students did not pay their fees despite signing an agreement with the NGO branch [see Appendix CC for fee payment agreement], the NGO branch felt compelled to take legal action. This resulted in a 'quaternary' contradiction between the FDE Activity System and the neighbouring legal Activity System [see Technology contradiction 118]. Inevitably the tensions between the students and the NGO lecturer impacted negatively on the teaching and learning situation, as one student wrote:

> Most of the classes I didn't attend because I was afraid of being embarrassed in front of my colleagues of *[sic]* not paying the fees. We are adults ... we are having responsibilities of our families and we are working under bad conditions ... so all of those things are affecting us and are frustrating.
>
> FDE student Portfolio (2000)

By not attending the lecture sessions the students jeopardised their chances of obtaining their Duly Performed (DP) certificate. The University Policy required students to attend 80% of the lecture sessions to receive a DP and sit the examination (University Calendar 1999a:209-110). When it became clear that not all the students met this requirement [see Technology contradiction 77], the students at risk were given a warning by the FDE co-ordinator [see Education contradiction 45]. In an attempt to resolve the contradictions, the FDE co-ordinator sent a letter to all the students drawing their attention to the DP requirements. By not attending all the lecture sessions in the respective Activity Systems, the students may have jeopardised their chances of developing the conceptual and physical skills required to be re-skilled as Technology learning area specialists (COTEP 1998: 79-80 and S.A. Government Gazette 2000:21).

Fourthly, the venue allocation at the University campus in City B was problematic and constrained the teaching and learning activities in the Education Activity System. Secondary contradictions emerged when the venues changed from one lecture session to the next [see Education contradiction 28] and since the students were not familiar with the layout of the campus, they could not find the venues. As a result, lecture sessions started late [see Education contradictions 7 and 49]. Additional pressure was therefore brought to bear on the Education Lecturer and the students to develop the conceptual understanding of educational theory in a shorter period of time than originally envisaged (COTEP 1996:119). The Memorandum of Agreement (1996) may therefore have constrained the actions and activities of the lecturers' and students in the teaching and learning environment and compromised the implementation of educational policy in the larger FDE Activity System.

Contradictions also emerged in the larger FDE Activity System across all four Activity Systems concerning the lecturers' 'rules'.

9.2 The lecturers' 'rule' contradictions

The lecturers' 'rules' pertained to all aspects of the teaching and learning activities in the lecture sessions. Contradictions emerged when the students did not abide by the lecturers' 'rules' concerning lecture sessions, equipment, homework and assignments, and the workshop.

9.2.1 Lecture session 'rule' contradictions

Numerous contradictions occurred in all four Activity Systems when the students did not abide by the lecturers' lecture session 'rules'. The contradictions are shown in Table 19.

Table 19. A description of the lecture session 'rule' contradictions in all four Activity Systems

LECTURE SESSION 'RULE' CONTRADICTIOINS	
Activity System	**Description**
Technology	1-The students (subjects) arrive late for lectures (Lecrule) 9-The students (subjects) do not switch their cell phones off and they regularly go off during class (Lecrule 21-The students (subjects) talk while the lecturer is explaining how to do the icon task (Lecrule) 55-The students (subjects) are bored and start to talk in their groups while the lecturer is talking (Lecrule) 103-The students (subjects) do not test their steam engines (Lecrule) 111-Only a few students (subjects) bring portfolios and completed steam model to class for 'work in progress' discussion (Lecrule)
Science	1-The students (subjects) come late for lectures and tea breaks (Lecrule) 2-The students (subjects) do not switch their cell phones off and they ring during the session (Lecrule) 14-The students (subjects) talk while the lecturer explains experiment (Lecrule) 32-The students (subjects) arrive late for class despite later starting time (Lecrule)
Mathematics	6-The students (subjects) come late to class (Lecrule) 7-The students (subjects) do not switch their cell phones off during the lecture sessions (Lecrule)
Education	8-The students (subjects) arrive late for class and after tea/lunch breaks (Lecrule) 12-The students (subjects) do not switch cell phones off and they ring during class (Lecrule) 40-The students (subjects) come late for the lecture session (Lecrule) and this creates tensions that the lecturer addresses

The most frequent and disruptive 'rule' that the students did not abide by occurred when the students regularly arrived late for the lecture sessions and did not return promptly after tea and lunch breaks [see Technology contradiction 1, Science contradiction 1 and 32, Mathematics contradiction 6 and Education 8 and 40]. The students' latecoming created a major problem for the lecturers, who did not know what to do about the situation. The NGO lecturer commented on this unsatisfactory state of affairs:

> Students really chip me off with their laid back attitude about arriving on time ... with regard to their forgetting to bring instruments, forgetting to bring themselves on occasions ... and that aspect impacts down the line because my lessons are typically geared to run for x number of hours and if they're starting twenty minutes or half an hour late or people are taking too long for tea etc ... All these little bits create a tension condition as you try to get through the exercise.
>
> Interview NGO lecturer (17 May 2000)

The Education lecturer expressed his dilemma thus:

> It is an issue that lateness disrupts and it upsets smooth running by introducing tension between the facilitator and individuals who do not warm up to the session for some time. Each late arrival puts a damper on ... and it is difficult as the facilitator not to 'throw one's toys out of the cot' but equally not to turn a blind eye.
>
> Education lecturer (9 October 2000 pers. comm)

The students persisted in coming late even when the lecture sessions commenced half an hour later in the second year. The students were aware of the rising tensions between themselves and the lecturers. The students attributed their lateness to not knowing which venue to go to on the University campus in City B in the Education Activity System, whilst this was not the case in the Technology, Science and Mathematics Activity Systems.

The students not only came late for lecture sessions, they also disrupted the lecture sessions when they did not switch their cell phones off [see Technology contradictions 9, Science contradiction 2, Mathematics contradiction 7 and Education contradiction 12]. The students ignored the constant reminders and the gentle pleas from the lecturers to switch their cell phones off and argued that they needed to be contactable on the days that they were absent from school. The 'out of town' students also wanted their families to be able to contact them if necessary (Field Notes Education Module 12 May 2000).

In addition, the students disrupted lecture sessions when they resorted to talking whilst the NGO lecturer explained the different tasks [see Technology contradiction 21 and 55 and Science contradiction 14]. Unfortunately the way the FDE contact sessions were structured may have made it difficult for the students to concentrate during the long lecture sessions. The students may have resorted to talking during lecture sessions as a result, particularly since they were seated in groups, which made talking much easier than if the students were seated individually in desks or in a row in a lecture theatre. By talking during lecture sessions the students showed a general lack of respect for their peers and lecturers and thus constrained the activities within the lecture sessions.

The students' actions were contrary to democratic principles and suggested that whilst the students felt they had a right to arrive late for lecture sessions and talk when they wanted to, they did not consider that they also had a responsibility not to infringe on the rights of other students to receive tuition or the lecturer's right to provide the tuition. South Africa's democracy is still in its infancy and the aim of Curriculum 2005 and OBE is to address the imbalances of the past. The contradictions suggest that the students may not have demonstrated the attitudes and values of a democratic society encompassed in the role of community and citizenship (COTEP 1998:76-78 and S.A. Government Gazette 2000:18-20) that is underpinned by OBE and Curriculum 2005 (S.A. DoE 1997b:16). The students' actions also showed a general lack of professionalism which may have constrained their chances of being re-skilled as Technology learning area specialists (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22).

The students also did not make use of the opportunities created by the NGO lecturer to improve their work during lecture sessions. The students were given the opportunity in the Technology Activity System to receive formative feedback from peers [see Technology contradiction 103 and 111]. In OBE terms this was an opportunity to receive constructive criticism to improve their work. The students however, did not make use of the opportunity before submitting their work for summative assessment. The students' unwillingness to engage in OBE assessment practices may have constrained their ability to demonstrate continuous and formative assessment (S.A. DoE 1997f:28-35) in the role of assessor (S.A. Government Gazette 2000:21), learning mediator (COTEP 1998:71-73 and S.A. Government Gazette 2000:15-16) and interpreter and designer of learning programmes (COTEP 1998:73-74 and S.A. Government Gazette 2000:16-17).

The students also did not bring the necessary equipment to the lecture sessions, thereby contributing to the lecturer 'rule' contradictions.

9.2.2 Equipment 'rule' contradictions

Primary contradictions occurred in three of the Activity Systems when the students did not abide by the lecturers' 'rules' concerning equipment. The contradictions are shown in Table 20.

Table 20. A description of the equipment 'rule' contradictions in the Technology, Science and Mathematics Activity Systems

EQUIPMENT 'RULE' CONTRADICTIOINS	
Activity System	**Description**
Technology	3-The students (subjects) do not bring their cutting mats and knives (Lecrule) 17-Some students (subjects) do not use all the paint that they mix and waste paint (Lecrule) 25-The students (subjects) do not bring pictures for the icon task (Lecrule) 113-The students (subjects) do not bring their 'face plates' (Lecrule)
Science	5-The students (subjects) do not bring science kits and microchem notes with them to class (Lecrule) 10-The students (subjects) do not obtain science textbooks applicable to the phase that they teach (Lecrule) 43-The students (subjects) do not bring/have calculators (Lecrule) 49-The students (subjects) do not bring their textbooks to class (Lecrule)
Mathematics	3-The students (subjects) do not bring their cutting mats and knives to class (Lecrule) 41-The students (subjects) do not bring calculators to class (Lecrule) 44-The students (subjects) do not bring math equipment for use in the class (Lecrule)

The students did not bring the equipment that they had been provided with or were supposed to provide themselves to the respective lecture sessions [see Technology contradictions 3, 17, 25 and 113, Science contradiction 5, 10, 43 and 49 and Mathematics contradictions 3, 41 and 44]. These primary contradictions contributed to the contradictions (discussed in Chapter 8 section 8.2) that dealt with the students not having the required equipment 'tools' in the respective Activity Systems to mediate their learning. Since OBE encourages individuals to take responsibility for their own learning, the students' actions may have constrained their ability to learn how to manage their classrooms and carry out administrative tasks that require discipline and forethought (S.A. DoE 1997b:16).

Further contradictions emerged concerning the lecturers' 'rules' when the students did not abide by the homework and assignment 'rules' in the Technology, Science and Mathematics Activity Systems.

9.2.3 Lecturers' homework and assignment 'rule' contradictions

Contradictions occurred in three of the Activity Systems when the students did not abide by the homework and assignment 'rules' that are listed in Table 21.

Table 21. A description of the homework and assignment 'rule' contradictions in the Technology, Science and Mathematics Activity Systems

HOMEWORK & ASSIGNMENT 'RULE' CONTRADICTIONS	
Activity System	**Description**
Technology	15-The students (subjects) do not learn the notes on structures and materials (Lecrule) 35-The students (subjects) do not study the notes on wood (Lecrule) 69-The students (subjects) challenge (StuDOL) the 10% deduction for late assignments (Lecrule) 79-The students (subjects) do not do the pre-reading (Lecrule) 87-The students (subjects) come late (Lecrule) because they have not completed their balancing toy assignments (StuDOL) 88-Most students (subjects) have not done both the model & the written assignment and want to hand one in without the other (Lecrule) 89-The students (subjects) hand their assignments in late and get penalised 10% (Lecrule) 90-The students (subjects) complete their written assignments (StuDOL) in class (Lecrule) 112-The students (subjects) have not answered the 100 TE questions (StuDOL)
Science	8-The students (subjects) do not do the experiments at home as required (Lecrule) 9-The students (subject) do not study the notes at home (Lecrule) 22-The students (subjects) do not conduct their own 'research' into science concepts (Lecrule) 38-The students (subjects) do math homework (StuDOL) that has to be handed in to-day (Lecrule) during the science lesson. 55-The students (subjects) do not do the examples from the textbook at home (Lecrule)
Mathematics	23-The students (subjects) do not study the math notes (Lecrule) 29-The students (subjects) do not study the notes (Lecrule)

A number of contradictions emerged as a result of the students not complying with the lecturer's homework and assignment 'rules'.

Firstly, the students did not do the homework preparation and/or did not complete the homework and assignment tasks by due date [see Technology contradictions 15, 35, 79, 88, 89 and 112, Science contradictions 8, 9, 22 and 55 and Mathematics contradictions 23 and 29]. The students may have found themselves in a 'double bind' situation with regards to developing conceptual 'tools' whilst doing homework and assignment tasks, given their under-preparedness. Some of the students may have had inadequate conceptual 'tools', compounded by a general poor linguistic ability, to engage with the homework and assignment tasks. Without the conceptual 'tools' to engage with the tasks, the students may not have been able to develop 'new' conceptual 'tools' to master the content of the Technology, Science and Mathematics Modules. Either way, they were not able to internalise and consolidate their conceptual thinking and further develop their conceptual understanding. As a result, the students may not have been able to comply with the lecturers' homework and assignment 'rules' and were therefore not able to develop their conceptual understanding in the respective Activity Systems (as discussed in Chapter 8 section 8.1.1).

The NGO lecturer implemented a 10% penalty if the assignments were not handed in by 09h00 on the due date and the students challenged the penalty for late submission [see Technology contradiction 69]. The students argued that the 10% penalty should only be imposed twenty-four hours after the due time and date. One student argued that the lecturer penalised them twice for late submissions:

> If you write your assignment during the lunch break you are not going to produce quality work and you will be marked down for that. If you hand it in late then you get penalised again by 10% so you are getting penalised twice.
>
> Interview FDE student (27 June 2000)

Secondly, some of the students came late to the lecture sessions when they had not completed their homework and assignment tasks [see Technology contradictions 87] whilst other students openly completed their homework and/or assignment tasks during lecture time [see Technology contradiction 90 and Science contradiction 38]. This meant that not only was their homework and/or assignment task inadequately done, the students also missed out on the work that was covered in the lecture session whilst they were completing these tasks. The students all had reasons for not being able to hand their homework and/or assignments on time. One student said:

> I come from the Transkei and had to wait at the Kei cuttings [a new road is being built and the traffic is held up while blasting is done]. I was therefore late and the lecturer had already said those who are late are going to get 10% less marks.
>
> Interviews FDE student (26 June 2000)

Another student gave her reasons as follows:

> I could not finish it on time at home because I did something else at first with paper mache and cardboard and it did not come out well. I had to make a special trip to [City B] to buy the dowel, drill bits and wood filler on Monday. My grandson lives with me and he was very sick the whole week from Monday. There was schoolwork marking and making schedules and working out mid-year marks. It was just all unreal and hectic!
>
> Interview FDE student (26 June 2000)

Yet another student conceded that she contributed towards her own predicament and said, "the problem is partly mine because I think I should have found time even if I had sick children" (Interview FDE student 26 June 2000).

One of the students suggested that the lecturer be more flexible:

> There needs to be more flexibility for part-time students. Part-time studies are very demanding because of all the other commitments teachers have.
>
> FDE Facilitator and student meeting (27 June 2000)

The students' actions suggested that they could not cope with the demands of the FDE as well as the demands of full-time work. Balancing multiple roles is a skill employers require in the workplace in an advanced technological society. Critical outcomes like organising and managing oneself (S.A. DoE 1997b:16) and the ability to take responsibility for one's own learning are outcomes that Curriculum 2005 is striving to achieve. Since the students had difficulty taking responsibility for their own learning, they may not able to demonstrate these critical outcomes and the role of leader, administrator and manager (COTEP 1998:75-76 and S.A. Government Gazette 2000:17-18).

9.2.4 Workshop 'rule' contradictions

The workshop used for practical activities in the Technology and Science Activity Systems housed the tools and equipment the students needed in the respective lecture sessions. Strict workshop 'rules' were enforced to ensure the safety of the students during the practical activities. Primary contradictions emerged when the students broke the workshop 'rules' [see Technology contradictions 8 and 32 in Appendix R]. Since the students did not have much experience with tools and equipment, in their excitement of using the equipment for the first time, they did not appreciate the potential danger the equipment could have if the workshop 'rules' were not adhered to.

A Technology learning area specialist should know how to use and maintain a range of equipment and tools. As educators in the school context, the students will be *in loco parentis* and therefore must be able to take reasonable steps to prevent accidents occurring whilst their learners are using equipment tools. The contradictions however, suggest that the students were not yet aware of the importance of safe practices in the workshop situation. An awareness of safe practices comes with experience - when one understands the necessity for having rules. As a result of the students not understanding the importance of the workshop rules they may not be able to use Technology critically and responsibility (S.A. DoE 1997b:16) in the role as learning mediator (COTEP 1998:71-71 and S.A. Government Gazette 2000:15-16) and leader, administrator and manager (COTEP 1998:75-76 and S.A. Government Gazette 2000:17-18).

The 'rule' contradictions in the four Activity Systems have been dealt with in this chapter whilst the contradictions concerning the 'division of labour' in the teaching and learning activities in the four Activity Systems will be discussed in the next chapter.

Chapter 10 Findings and Discussion – The 'division of labour' element

The contradictions that emerged within the division of labour 'element' concerned the students' and lecturers' actions in the four Activity Systems in relation to the 'object' of the larger Activity System. The 'division of labour' element refers to both the horizontal division of tasks between the students and the lecturers and the vertical division of power and status. The students' and lecturers' actions will be presented in turn.

10.1 The students' division of labour strategies

The contradictions concerning the students' 'division of labour' in the teaching and learning activities, mostly concerned 'time on task', 'peer support' and 'copying and plagiarism' contradictions.

10.1.1 'Time on task' contradictions

Contradictions emerged when the students were not able to complete the tasks in the available time in the four Activity Systems. The students' 'time on task' contradictions are shown in Table 22.

Table 22. A description of the students' 'time on task' contradictions in the Technology, Science and Mathematics Activity Systems

STUDENTS' 'TIME ON TASK' CONTRADICTIONS	
Activity System	**Description**
Technology	6-The students (subjects) take a long time to do enlarging and rendering (StuDOL) and do not complete the task (Lecrule) 19-Some students (subjects) do not complete painting their boxes (StuDOL) in the time available (Lecrule) 36-The students (subjects) do not complete the icon task (StuDOL) in the time allowed (Lecrule) 42-The students (subjects) do not complete the gadget design task (StuDOL) in the time allowed (Lecrule) 47-The students (subjects) do not complete the library task (StuDOL) in the time allowed (Lecrule) 86-The students (subjects) do not complete the hydraulic model (StuDOL) in the time allowed (Lecrule) 102-The students (subjects) do not complete the steam engine task (StuDOL) in the time allowed (Lecrule)
Science	17-The students (subjects) do not complete experiment 5.8 (StuDOL) in the time available (Lecrule) 29-The students (subjects) do not complete the cross-curricular task (StuDOL) in the time available (Lecrule) 34-The students (subjects) cannot do the moment and couple examples (StuDOL) in the time allowed by the lecturer during the lecture (Lecrule)
Mathematics	8-The students (subjects) take a long time to draw Pascal's triangle (StuDOL) and do not complete the task (lecrule) 34-Some students (subjects) do not have enough time (Lecrule) to do the area calculations (StuDOL) 38-The students (subjects) talk while the lecturer is explaining (Lecrule) because they are still trying to do the area calculation with the help of the group (StuDOL) 55-The students (subjects) do not complete the patterns and puzzles worksheet (StuDOL) in the lecture session and are required to do it for homework (Lecrule)
Education	22-The students (subjects) take a long time to reach consensus on how to design an OBE lesson (StuDOL) and there is not enough time to complete the task (Lecrule) 29-The students (subjects) find it difficult to reach consensus (StuCtool) on how the lecturer must mark mini-test (Lecrule)

Since the students were confronted with doing tasks and using equipment for the very first time, they took a long time to do the tasks and often did not complete the tasks in the available lecture time [see Technology contradictions 6, 19, 36, 42, 47, 86 and 102, Science contradictions 17, 29 and 34, Mathematics contradictions 8, 34, 38 and 55 and Education contradictions 2 and 29]. Whilst the students did their best to complete the tasks and develop the conceptual understanding and skills demanded by the different tasks in the Technology, Science, Mathematics and Education Activity Systems, most of the students felt that they could not complete the tasks in the time available. One of the students put it this way, "The time we are attending is too short for the workload. Apart from that the work given is challenging and the more you are trying to do it ... you become tired" (Interview FDE students 6 August 2000) while another student said, "Too much work is required in a very short period. Seemingly the focus now shifts from quality to quantity because it is rushed" (Interview FDE students 6 August 2000).

The students however contributed to the time constraints by arriving late for lecture sessions, disrupting the lecture sessions by having their cell phones on and talking during lecture sessions (as discussed in Chapter 9 section 9.2.1). The students' actions may have further constrained their ability to develop the content knowledge and physical skills needed to demonstrate the role of Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22).

Educational policy does not take into consideration that time in the FDE was limited since it is not possible to have flexible time frames and allow the students to work at their own pace as suggested in OBE (S.A. DoE 1997b:7). Given the students' initial under-preparedness, it may not have been possible for the students to acquire the necessary skills and knowledge suggested in the University FDE Syllabus (1998) in a part-time programme. As a result it may not have been possible to re-educate the students to demonstrate competence as a Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22) in a two-year, part-time FDE.

10.1.2 'Peer support' contradictions

The students' actions in all four Activity Systems led to contradictions between the division of labour 'element' and other 'elements' concerning 'peer support' as shown in Table 23.

Table 23. A description of the students' 'peer support' contradictions in all four Activity Systems

STUDENTS' 'PEER SUPPORT' CONTRADICTIONS	
Activity System	**Description**
Technology	14-The students (subjects) sit in groups (Lecrule) but work individually (StuDOL) 33-The students (subjects) speak Xhosa (StuCtool) in their groups (Sturule) and the lecturer does not understand what they are saying 37-The students (subjects) sit in groups (Lecrule) but work individually (StuDOL) 76-The students (subjects) work individually (StuDOL) but the desks are arranged in groups (Lecrule)
Science	20-The students (subjects) speak Xhosa (Sturule) and the lecturer does not know (LecCtool) if they understand the science concepts correctly 45-The students (subjects) with calculators do the calculations (StuDOL) and others copy the answers from these students (Sturule) 56-The students (subjects) do not work individually but in groups (StuDOL), so cooperative activity is subverted (LecCtool) 60-The students (subjects) find it difficult to do the examples (StuCtool) and ask others in the group for assistance (StuDOL) 66-The students (subjects) arrange the desks (StuDOL) in groups (Sturule) before the lecturer arrives 70-Some students (subjects) do not know how to work out the charge examples (StuCtool) and ask their friends for assistance (StuDOL)
Mathematics	22-The students (subjects) do not know how to do the fraction calculations (StuCtool) and ask their peers for help (StuDOL) 39-The students (subjects) do not know how to do area calculations (StuCtool) and ask group for help (StuDOL) 51-The students (subjects) are very reluctant to change their groups (Sturule) because there are only five puzzles (LecEtool) 52-Some students (subjects) have never done a puzzle before (StuCtool) and this caused anxiety and some students wanted to give up (StuDOL) 61-The students (subjects) appear upset and are talking in Xhosa (StuCtool) so that the lecturer cannot understand (Lecrule), leading to tension in the room.
Education	22-The students (subjects) discuss in Xhosa (StuCtool) in 'expert' groups and the lecturer cannot facilitate their discussions (Lecrule)

The tables and chairs in the lecture venue at the NGO branch where the Technology, Science and Mathematics lecture sessions took place were positioned around the room and were always arranged in groups to seat five or six persons. The students therefore sat in groups for most of the lecture sessions irrespective of the types of activities they were involved in [see Technology contradictions 14, 37 and 76, Science contradictions 45, 56, 60, 66 and 70 and Mathematics contradictions 22, 39, 51 and 52]. The group seating arrangement may have created the perception that 'sitting in a group' was the same as 'group work' mentioned in OBE (S.A. DoE 1997b:7). The students however did not engage in 'group work' since they sat in their groups whilst mostly working on individual tasks in the Technology, Science and Mathematics Modules. Just interacting with one's peers is not sufficient to promote learning since peers may be misled by each other's misunderstandings. For meaningful learning to take place, the lecturer must make the goal and type of interaction explicit (Bodrova and Leong 1996:118). These authors cite Vygotskians who describe the following peer interactions as the most beneficial for development: co-operating to successfully complete a task, assuming assigned roles and acting as a sounding board for a peer (p.118-119).

In the Education Module however, each member of the group was required to contribute to the discussion or task assigned to the group, which was in line with an OBE 'group work' strategy and may have contributed to learning as outlined above. However, the Education lecturer did not mention different roles like 'leader', 'scribe' and 'gate-keeper' that the group members were expected to adopt whilst doing the group tasks, neither were these roles 'taught'.

It may have been beneficial for the weaker students to seek the help of their peers whilst sitting in their groups in the short term, since knowledge is first shared between individuals before being internalised (Vygotsky, 1978). However, the peers may not have had adequate conceptual 'tools' (as discussed in Chapter 8 section 8.1.1) to develop their fellow students' conceptual 'tools' (see Chapter 10 section 10.3). The students precipitated secondary contradictions by speaking Xhosa in their groups [see Technology contradiction 33, Science contradiction 20, Mathematics contradiction 61 and Education contradiction 22] that constrained the lecturers' ability to facilitate their learning experiences whilst engaging in discussions in all four Activity Systems. Since the lecturers did not speak Xhosa they were not aware of any conceptual shortcomings that may have emerged when the so-called peer 'experts' inadvertently used inadequate conceptual 'tools' during discussions.

The groups may have been beneficial at an interactive level for the students to share ideas, but the groups may have been a drawback at a social level when the students used the opportunity to chat and not to concentrate on the task at hand, which may have constrained the students' ability to develop the conceptual and physical skills needed to become Technology experts (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22).

The students adopted strategies to cope with the demands made on them in the respective Activity Systems, which led to contradictions concerning the issue of 'copying and plagiarism'.

10.1.3 'Copying and plagiarism' contradictions

Further contradictions emerged in the Technology, Science and Mathematics Activity Systems as a result of the students' actions concerning 'copying and plagiarism'. The contradictions are shown in Table 24.

Table 24. A description of the students' 'copying and plagiarism' contradictions in the Technology, Science and Mathematics Activity Systems.

STUDENTS' 'COPYING AND PLAGIARISM' CONTRADICTIONS	
Activity System	**Description**
Technology	39-The students (subjects) do not 'design' a gadget to remove the toxic waste (StuCtool) but copy and adjust an existing design of a gadget (StuDOL) from the notes 73-The students (subjects) do not 'design and make a balancing model' (StuCtool) but trace, cut and decorate an existing design (StuDOL) 92-Some students (subjects) hand in models/assignments done by other students (StuDOL)
Science	25-The students (subjects) do not know how to sketch the water cycle (StuCtool) and copy the lecturer's drawing from the board (StuDOL) 30-The students (subjects) do not want to make mistakes (Sturule) and rely on the lecturer (as the authority) to give them the answers (LecDOL) 35-The students (subjects) copy (StuDOL) the solutions from the ohp without knowing how to do the calculations (StuCtool)
Mathematics	64-The lecturer (subject) explains and students copy calculations (StuDOL) without really understanding symbols and concepts (StuCtool)

Firstly, contradictions emerged in the Technology Activity System when the submitted models that were either made by other people or copied from other students' assignments [see Technology contradiction 92]. One student mentioned in her portfolio that she felt powerless to do anything about this practice by students:

> One unfortunate situation is that there are other people who submit their tasks on time, there are others who wait to copy others' ideas then they rush to the nearest DIY and quickly put something together and submit. Unfortunately, we are hopelessly disadvantaged and helpless with regards to this situation or state of affairs.
>
> FDE student portfolio (2000)

The reasons for plagiarising may be related to the students' inability to feel confident in doing the tasks that were required of them (see Chapter 8 section 8.1.6). A possible explanation may be that when students "know they have something to say but do not know how to say it, what better way to try to communicate than to mimic – mimic the 'voices' of those they know have authority" (Shay, Bond and Hughes 1996:17). Angelil-Carter refers to students who plagiarise as 'squatters' and says "for new students, newly entering the academic discourse, and having to start using the discourses in assignments, there is no other way than to be a squatter, to live in the discourses of academia without owning them" (Angelil-Carter 1995:82). Lecturers therefore have to provide students with support and assistance so that they feel confident in expressing their views in the way the academy requires, without resorting to plagiarism.

Secondly, the students acknowledged the NGO lecturer's expertise and authority and relied on him to give them the answers when they did not have the conceptual understanding or appropriate skills to engage in the tasks and activities in the respective Activity Systems [see Technology contradictions 39 and 73, Science contradictions 25, 30 and 35 and Mathematics contradiction 64]. The students' strategy may not have been appropriate or effective in dealing with the demands of the FDE, since it did not lead to greater understanding, which may have been exacerbated by their under-preparedness and inadequate conceptual understanding and skills development.

Contradictions also emerged between the lecturers' actions and the 'elements' in the teaching and learning activity in the four Activity Systems.

10.2 The lecturers' strategies in the teaching and learning activity

The lecturers adopted different strategies to meet the demands of the different Activity Systems in relation to achieving the 'object' of the larger Activity System. Contradictions emerged when these strategies were not successful. Similar contradictions emerged concerning the issue of 'assessment' across all four of the Activity Systems that will be discussed after the contradictions concerning the lecturers' strategies are presented. The lecturers' strategy contradictions are shown in Table 25.

Table 25. A description of the lecturers' 'strategy' contradictions in the Technology, Science and Mathematics Activity Systems

THE LECTURERS' 'STRATEGY' CONTRADICTIONS	
Activity System	**Description**
Technology	11-The lecturer (subject) tells the students how to make a cardboard box (LecDOL) and students have problems (StuCtool) 12-The lecturer (subject) demonstrates and explains how to assemble paper mache box (LecDOL) and the students have problems (StuCtool) 16-The lecturer (subject) demonstrates how to mix paint (LecDOL) and some students mix large quantities of paint and add too much water (StuCtool) 24-The lecturer (subject) demonstrates the icon task (LecDOL) and the students do not know what to do (StuCtool) 51-The lecturer (subject) explains concepts like forces, levers and gravity (LecCtool) by using the 'lecture' method and the students sit and listen (StuDOL) 84-The lecturer (subject) demonstrates and explains hydraulic task (LecDOL) yet the students do not know what to do (StuCtool)
Science	7-The students (subjects) are not familiar with using the equipment in the science kits (StuCtool) and only do Exp 5.1-5.3 (Lecrule) 21-The lecturer (subject) gives the answers (LecDOL) when the students are unable to explain the concepts (StuCtool 26-The lecturer (subject) uses Q & A strategy to revise concepts (StuCtool) and the students get bored (StuDOL) 36-The lecturer (subject) does revision by doing examples on ohp (StuCtool) and this leads to frustration and boredom (StuDOL) 54-The lecturer (subject) explains and demonstrates (StuCtool) leading to students becoming bored (StuDOL) 61-The lecturer (subject) repeats the pulley demonstration (LecDOL) and students do not listen (Lecrule) 69-The students (subjects) do not know how to write an electron equation (StuCtool) and the lecturer realises this and tells them how to do it (LecDOL) 71-Students (subjects) raise cultural beliefs about lightening (StuCtool) and the guest lecturer affirms another 'way of knowing' (LecDOL)
Mathematics	12-The lecturer (subject) does not give the students enough time (Lecrule) to complete the calculations to apply BODMAS (StuCtool) 24-The lecturer (subject) gives the solution (LecDOL) without the students understanding the concepts (StuCtool) 35-The lecturer (subject) gives the solutions (LecDOL) before the students grasp the concepts (StuCtool) 40-The lecturer (subject) is doing all the talking (LecDOL) and students cannot follow his explanation of the concepts (StuCtool)

Whilst the strategies adopted by the respective lecturers were different in the four Activity Systems, the Technology, Science and Mathematics Activity Systems will be discussed first, followed by the Education Activity System.

10.2.1 The Technology, Science and Mathematics Activity Systems

The NGO lecturer was aware of the students' under-preparedness with regards to motor-skills development in the Technology Activity System:

> ... Most of the students come with very, very low motor skills development and this course enhances those skills dramatically. Most of our teachers came from a very prescriptive background ... typically chalk and talk and a rote-learning environment. This programme encourages lateral thinking, diversity, creativity ... It's a skills development programme.
>
> Interview NGO lecturer (26 August 1999)

Since the students had a limited understanding of Technology and were doing practical tasks for the first time, the NGO lecturer adopted an 'expert-novice' strategy in practical activities in the Technology Activity System. As the 'expert' he demonstrated and explained how to do the practical task before the students, who were considered 'novices' attempted to do the tasks or use the equipment. Whilst the NGO lecturer intended the students to work at their own pace while he facilitated the tasks, due to time constraints, he resorted to telling the students what to do in the different tasks [see Technology contradictions 11, 12, 16, 24 and 84]. Telling the students what to do, constrained the students' ability to develop their conceptual understanding and skills to become independent learners since they relied on the lecturer to tell them what to do.

In addition, the NGO lecturer relied on the traditional 'lecture' method to teach the theoretical concepts [see Technology contradiction 51] in the Technology Activity System. Unfortunately this approach did not enhance the students' learning since they did not have an adequate conceptual understanding of technological, scientific and mathematical concepts or the conceptual 'tools' dealt with in the Technology Activity System on which to base their understanding (as discussed in Chapter 8 section 8.1.1).

In the Science Activity System the NGO lecturer adopted a 'self discovery' approach to practical activities where the students were required to do experiments using their microchemistry science kits and the accompanying notes while the lecturer acted as a facilitator. The students however did not have sufficient prior knowledge of the Science equipment for this strategy to successfully develop their understanding in each experiment [see Science contradiction 7]. One student suggested that the lecture sessions could be improved:

> There should be overall discussions that is, what is expected should be discussed ... not do experiments on your own and no summary given to see whether you were on the right track or not.
>
> Interview FDE student (31 July 1999)

The success of the 'self discovery' method may have been constrained by the students' lack of conceptual understanding of basic scientific concepts like atoms, molecules, elements and the periodic table which may have led to later contradictions in the electricity lecture session [see Science contradictions 69 and 71].

Since the NGO lecturer was aware that most of the students were unsure of the scientific concepts he adopted a 'question and answer' method to revise and explain concepts on the chalkboard [see Science contradictions 26 and 36]. Some of the students participated while the other students listened and/or took notes. Unfortunately, this strategy resulted in student boredom since the students mostly sat and listened [see Science contradictions 54 and 61]. The students acknowledged the NGO lecturer as the 'expert' and relied on him to give them the 'correct' answers [see Science contradiction 21]. By relying on the lecturer to give them 'correct' answers, the students did not explore the possibility of finding the answers for themselves. The NGO lecturer therefore may have contributed to the students not becoming independent learners by reinforcing their reliance on him. The NGO lecturer however, expected the students to be independent learners:

> I keep trying to improve the way I do things and I think next time I do it some of the things I did yesterday will impact, but I don't think there's much that needs to change. Having said that, I'm saying to myself everything has to change but I really believe that I think from a teaching, lecturing, preparation, presentation point of view, I'm doing a hell of a lot. I think now the students have to come to the party. They're keen to be passive in an environment which is actually encouraging them to be active. So its not as if they're being ... in fact it sometimes does end up this way. You drone onto them because they don't want to move forward.
>
> Interview NGO Lecturer (17 March 2000)

In the Mathematics Activity System the NGO lecturer adopted a 'tried and tested' method that he believed would enable the weaker students to meet the 'object' of the Mathematics Activity System:

> Something I stand by and this is years of experience ... is when you're dealing with students who are weak ... I'm not talking about the strong guys. When you're dealing with students who are weak, you actually have to create a pattern for them to be able to achieve a solution and part of the requirement of that pattern is a condition where we work in a neat and ordered ... structured way. Now children who are dynamic mathematicians fly through many mental processes which other children, less gifted children, can't do. But if you do work in this way and I had the experience, you can actually turn even weak candidates into success cases.
>
> Interview NGO lecturer (17 March 2000)

The NGO lecturer's strategy consisted of (1) the lecturer demonstrating or explaining how to do a mathematical example or problem, (2) the students practicing a couple of examples, and (3) the lecturer giving the solutions for the examples on the overhead projector or green board.

The 'three-step' strategy may not have developed the students' understanding since the students did not grasp the mathematical concepts whilst the lecturer was explaining the examples [see Mathematics contradiction 40]. The students also did not have enough time to practise the examples before the solutions were given [see Mathematics contradictions 24 and 35]. Whilst the NGO lecturer needed to cover a certain amount of work during each lecture session to meet the requirements of the University FDE syllabus (1998), he felt compelled to stop the students when they took too long to complete the examples [see Mathematics contradiction 12] before briefly going through the solutions and moving on to the next planned activity or exercise. Whilst it is important to provide "regulative cues and other instructional prompts" for weaker students (Craig and Winter 1990:59) it is equally important to provide the kind of learning opportunities that will allow students to develop and internalise knowledge to engage with problem-solving autonomously.

The 'three-step' strategy may have been inappropriate for developing autonomous problem-solving skills required in the workplace. Firstly, it assumed that problem solving in mathematics involved the application of well-learned procedures and ignored the complex nature of problem-solving that develops over a period of time and involves more than just mathematical content knowledge. Secondly, it promoted the idea that there was only one 'correct' solution and was not conducive to developing problem-solving skills for ill-structured problems with 'multiple' solutions.

The acquisition of cultural and mental 'tools' depends on whether the 'tool' lies within the individual's zone of proximal development (ZPD), according to Vygotsky (1978). The ZDP has two levels within which learning may lead to development: the lower level is what the individual knows and can do, and the upper level is what the individual can achieve with assistance. In the Technology, Science and Mathematics Modules the lecturer had in mind the goals for the lecture sessions and what learning he expected from the students, and implemented strategies that he expected would lead to development. The students however entered the FDE with limited prior knowledge and skills and the assistance that the lecturer provided through the lecture strategies may not have been successful since they were not within the students ZPD. Given the students' initial under-preparedness, it may have been unrealistic to expect the NGO lecturer to develop the physical and conceptual skills that they required to successfully re-educate the students as Technology learning area specialists (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22) within the time constraints of the FDE.

In addition, perhaps there was not enough time in the larger FDE Activity System to give the students the opportunity to develop their learning whilst implementing the University FDE syllabus (1998) to meet the requirements of re-educating the educators as Technology learning area specialists (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22).

10.2.2 The Education Activity System

No overt contradictions emerged in the Education Activity System since the Education lecturer/FDE facilitator and the Education lecturer were not required to guide the students in demonstrating concrete evidence of their knowledge and skills whilst 'making' an artifact or 'doing' an experiment or calculation as was the case in the Technology, Science and Mathematics Activity Systems. Since the Education lecturer/FDE facilitator and the Education lecturer adopted a 'facilitation and discussion' strategy in most of the lecture sessions, it was possible to facilitate discussions within the time constraints of the lecture sessions by simply stopping the discussion at a predetermined time. A disadvantage of this strategy however was that there was very little evidence to indicate whether the students had successfully developed their conceptual understanding during the discussion sessions.

The 'assessment' contradictions pertaining to all four Activity Systems are now presented.

10.3 The lecturers' 'assessment' contradictions

Contradictions emerging in the four Activity Systems concerning the issue of 'assessment' are shown in Table 26.

Table 26. A description of the lecturers' 'assessment' contradictions in all four Activity Systems

LECTURERS' 'ASSESSMENT' CONTRADICTIONS	
Activity System	**Description**
Technology	20-The lecturer (subject) does not refer to notes again (LecDOL) to check the students' understanding (StuCtool) 52-The lecturer (subject) demonstrates and explains concepts like forces, levers and gravity (LecDOL) and the students do not understand concepts (StuCtool) 61-The lecturer (subject) discusses concepts like force, gradient, levers (LecDOL) without checking the students' understanding (StuCtool) 82-The lecturer (subject) discusses the concepts gravity and moments (LecDOL) and the students do not understand the concepts (StuCtool)
Science	3-The lecturer (subject) discusses concepts like fundamental forces, atomic structure and periodic table (LecDOL) without checking the students' understanding of the concepts (StuCtool)
Mathematics	13-The lecturer (subject) discusses concepts like multiples, factors, sequences and series (LecDOL) without checking the students' understanding (StuCtool) 30-The lecturer (subject) discusses ratio and proportion (LecDOL) without checking for students' understanding (StuCtool) 82-The lecturer (subject) covers concepts like refraction, congruent-, similar – complementary- and supplementary triangles in one three hour session (StuCtool) without checking for understanding (LecDOL)
Education	15-The lecturer (subject) discusses learning theories (LecDOL) without checking the students' understanding (StuCtool) 24-The lecturer (subjects) never gave the students the opportunity to (Lecrule) present their assignments (StuDOL) to the rest of the class 30-The students' (subjects) year mark does not include classwork, presentations and journal (LecCtool) as stated in documents (Lecrule)

Contradictions emerged when the students were given additional notes and reading as examinable material without the students' understanding of the notes being assessed [see Technology contradiction 20]. The NGO lecturer indicated that his strategy was the following:

> I'm going to require them [the students] in terms of the readings ... I'm going to ask them to read for the next session and much like the B.Ed group do I'm not going to question the students on that ... I am going to indicate to the students that some of the questions will form part of the questioning which occurs in the exam paper. Not necessarily the same words, but questions will be generated based on that.
>
> Interview NGO lecturer (17 March 2000)

In addition, the NGO lecturer demonstrated and explained concepts whilst checking the students' understanding informally through discussion [see Technology contradictions 52, 61 and 82, Science contradiction 3 and Mathematics contradictions 13, 30 and 82]. The NGO lecturer expressed his satisfaction with this approach after one of the lecture sessions:

> I think with regards to knowledge, by the time they completed the exercise the sorts of questions which were being fielded by me gave me the impression that there was clarity in their minds. They were asking questions around center of gravity, moments and torque and I think we touched on couples. So I think the knowledge base has grown.
>
> Interview NGO lecturer (17 March 2000)

The NGO lecturer also relied on the student 'experts' in the groups to supplement his assessment approach and explained:

> Assessment will be done by observation and because the students are working in a 'community of enquiry' their peers will, for a great part, lead stragglers ahead. So in other words they're going to discuss these issues. I hope to see that the groups will pull together and will help one another through the possible mathematical problems which may manifest.
>
> Interview NGO lecturer (17 March 2000)

The NGO lecturer's approach may not have taken into consideration the fact that relying on the peer groups was problematic. Firstly, the students were not sufficiently knowledgeable to be considered 'experts' therefore there was a limit to what they could be expected to achieve. Secondly, since the students were not 'experts' they may have contributed to the conceptual confusion of their peers by using inappropriate and/or inadequate conceptual 'tools'. Thirdly, problems may also have arisen since the students spoke Xhosa in their groups and the lecturer may not have been aware of what the students were discussing (see section 10.1.2).

In the Education Activity System the assessment schedule given to the students indicated that the students' year mark was to consist of class work, presentations and journals. The Education lecturer/FDE co-ordinator and Education lecturer however did not give the students the opportunity during the lecture session to present their assignments [see Education contradiction 24]. The students' journals were also not included in the year mark assessment since the students did not keep regular 'reflections' as they were required to do [see Education contradiction 30].

Furthermore, the Education lecturer/FDE co-ordinator assumed that the students had a 'grounding' in Education theory from their previous education. She thus discussed the learning theories during the lecture session without checking the students' understanding [see Education contradiction 15]. Since the Education lecturer/FDE co-ordinator's assumption proved incorrect, the students may not have had an adequate conceptual understanding of the learning theories to be re-educated to improve classroom practice as required in COTEP (1998) and S.A. Government Gazette (2000).

Apart from assignments, summative assessment was done at the end of the first and second year of study in all four Activity Systems. By mainly assessing the students summatively, the lecturers missed the opportunity to develop the students' understanding through formative assessment (S.A. DoE 1997f:30-35). The purpose of formative assessment is to give feedback to the students on their learning progress or lack thereof. Without formative assessment it was difficult for the lecturers to know exactly which students did not have the conceptual 'tools' to further develop their understanding of the concepts in the respective Activity Systems. The students' misconceptions were therefore difficult to remedy on an individual basis. Without regular formative assessment the lecturers may have contributed to the students' learning not being optimally realised. The lack of feedback on the students' progress may have contributed to the lecturers' inability to develop the students' conceptual 'tools' needed to demonstrate their expertise as Technology learning area specialists (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22) and to reach the 'object' of the larger FDE Activity.

The contradictions concerning strategies engaged in by the students and the lecturers in the larger FDE Activity System have been outlined in this chapter. In the next chapter the findings from the school context are presented and discussed.

Chapter 11 Findings and Discussion - Technology in the school context

In this chapter the findings from the two Technology lessons presented in the school context by two students, who successfully completed the Further Diploma in Education (Technology), discussed as the larger FDE Activity System in Chapters 6, 7, 8 and 9, will be presented and discussed in relation to educational policy. The purpose of this analysis is to provide insights into the ways in which teaching and learning in the FDE are translated into practice in the classroom.

The two Technology lessons, Lesson A and Lesson B were presented at two urban 'township' schools, School A and School B respectively. In the process of analysing the data, each of the Technology lessons were taken to be an Activity System with each lesson having specific goals and a range of activities to achieve those goals. The 'subjects' in Lesson A and Lesson B were the learners and educators. The educators will be referred to as Educator A in School A and Educator B in School B. The 'elements' namely, 'tools', 'rules', 'division of labour' and 'community' and the contradictions found within each of the 'elements' in the two Activity Systems were analysed independently [see Appendix P and Appendix DD for details of the contradictions in Lesson A and Lesson B respectively]. Considerable similarities in contradictions across the two Activity Systems were found to exist. Where differences in contradictions were found across the two Activity Systems these are documented. A brief background of School A and School B will first be given to provide a context for Lesson A and Lesson B respectively.

11.1 The school contexts

11.1.1 Background School A

School A is an urban 'township' school not far from City B. Once you turn off the main tarred road the roads to the school are gravel and in a very bad state of repair. The school is on the top of a hill behind a police station. The school was built in the standard architectural 'style' for township schools in the apartheid era, consisting of two rows of buildings parallel to one another with a quadrangle between the two rows of buildings. The school buildings were in a reasonable condition although the surrounding grass was long and the grounds unkempt. A fence surrounded the school grounds but there was no gate at the entrance, which was a little way away from the main building as illustrated in Figure 10.

Figure 10. The view of School A from the front gate

The Principal's office was at the end of one of the buildings. The office had a desk and two chairs in the middle of the room and there was a steel and wooden cupboard (filled with Science and other resource material) positioned along the one wall and a filing cabinet on the opposite wall. There was a telephone that had been disconnected since the school could not afford to pay the account. The notice board had official Department of Education notices as well as sports notices pinned to it. A few absentee notes were also pinned to the board. A timetable was stuck to the wall above the filing cabinet and a chalkboard with attendance figures was attached to the opposite wall. There was a door behind the desk leading to a storeroom. The door was open and there was a big puddle of water on the floor where the recent rain had fallen through a hole in the roof. Stacks of paper were piled in the corner of the storeroom along with hoses and spades and forks. Only the Principal's office was supplied with electricity in pre-paid form whilst security in the form of burglar proofing was found on the windows.

The township area where School A is located is considered 'well to do', however the parents in the community are no longer sending their children to the school, instead choosing to send their children to previously 'white' schools in City B. As a result of the community not supporting the school, numbers have dropped from 600 learners in 1992 to approximately 190 learners in 2001. At present there are two classes each for Grade 5, 6 and 7. The school has a male Principal, one female Head of Department and five educators (three females and two males) The learners who attend the school come from the poorer parts of the community and nearby squatter settlements. The parents are required to pay R30.00 school fees per year but very few actually pay. Many learners live with relatives or grandparents who are pensioners.

There was a staff-room (an ordinary classroom with the desks removed) in the row of buildings opposite the Principal's office, however none of the educators seemed to use it. The classroom next to the staff-room was used as a 'resource room' for Technology and also served as a 'library' where reading books, supplied by an NGO, were kept. The 'resource room' was not well kept and it looked as if it had not been used recently since the projects on 'display' were covered in dust. There were two adjoining classrooms next to the 'resource room' without a dividing wall and this large classroom was called the school 'hall'. There were ten groups of desks accommodating approximately 60 learners in the 'hall'. Tests were often written here since the room was big enough to accommodate two classes. Two other classrooms in the school were empty (except for one or two desks), while the learners and educators in the school occupied the remaining classrooms. The learners moved from classroom to classroom during the school day depending on the learning area presented by a particular educator.

Lesson A took place in the 'hall' with both Grade 7 classes (approximately 60 learners) seated at the grouped desks as illustrated in Figure 11.

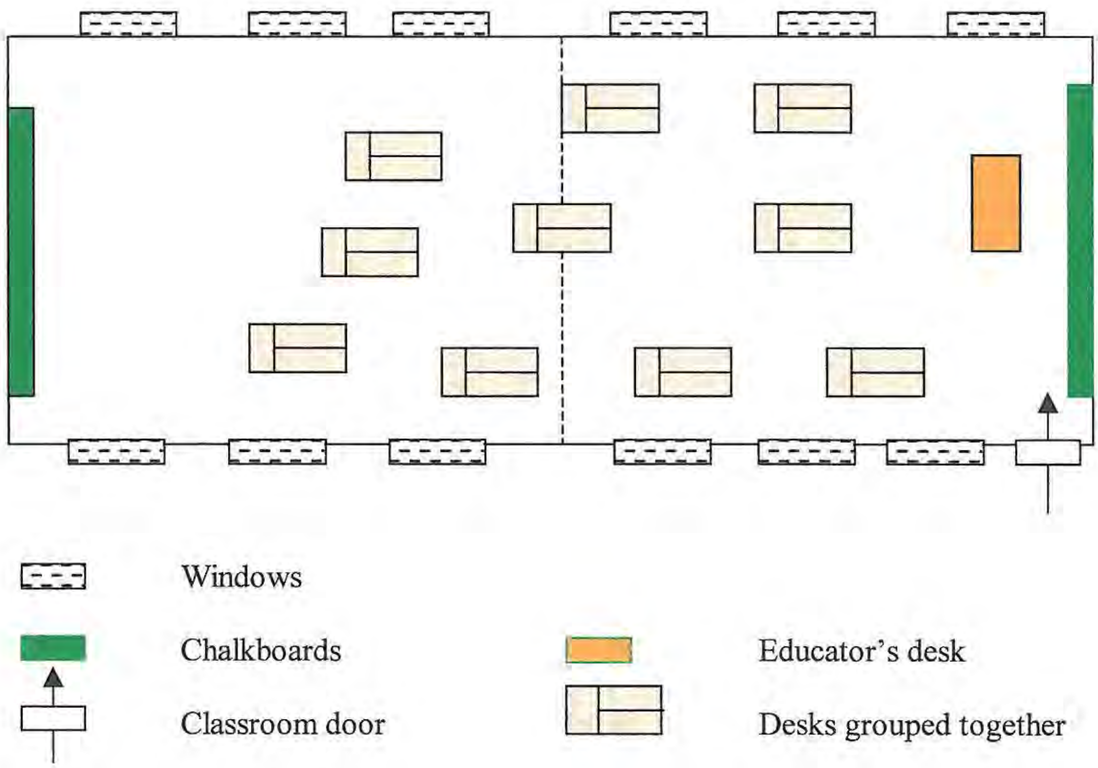


Figure 11. The 'hall' classroom arrangement at School A

Whilst School A and B were both urban township schools they were different with respect to size and resources.

11.1.2 Background School B

School B is an urban township school on the outskirts of City B. The road to the school is tarred and in fairly good condition. A fence was erected around the perimeter of the school and there was a gate through which cars and pedestrians could enter. The school was built in the standard architectural style for township schools and it was possible for a car to drive between the two rows of buildings into the central courtyard. The school's name was printed on a large sponsored signboard in the front of the school grounds and the school buildings were neatly painted. The Principal's office and the classroom doors had security gates and all the windows were burglar proofed. Figure 12 shows the school courtyard and the school buildings.

Figure 12. A view of School B courtyard and school buildings

The Principal's office was at the end of the one row of buildings. A large desk and executive chair were positioned to one side with a table forming an L shape for easy access to the telephone. A computer on a stand was positioned behind the desk. Next to the desk were two filing cabinets with six trophies (for music and sport) as well as a fern displayed on top of the filing cabinets. A timetable for the whole school was stuck on the wall, next to a poster of the South African Council of Educators' Code of Conduct. A safe was built into one of the walls and fourteen chairs were positioned along the sides of two of the walls. A chalkboard with the educators' names, classes and class sizes, showed a total enrolment of 707 learners. The five Grade 5 classes had approximately 60 learners in each class while the four Grade 6 and four Grade 7 classes had 45 learners in each class. There were fifteen educators including the Principal, Deputy Principal and two Heads of Department. The Principal and Deputy Principal did not have a classroom whilst each of the thirteen educators had their own classrooms.

Behind the one row of buildings was the 'sports fields' that consisted of a large open piece of ground with waist-high grass. The school had to pay a contractor to mow the grass and the prohibitive cost meant that the area was mowed infrequently.

The building adjacent to the Principal's office was still being built and consisted of a large room to be subdivided into two offices, a large computer laboratory, staff toilets and a small library. The community was funding the building since no money was forthcoming for the project from the Department of Education. Each family was asked to pay R70.00 for the building project in addition to the R100.00 per annum school fee. This was a substantial amount given that most of the children attending the school lived with their grandparents (who are pensioners) since their parents were unemployed or looking for work in another city. The school was short staffed and was entitled to three more educators for the 707 learners who attend the school (based on a 1:40 ratio for primary schools), however the Department of Education failed to appoint the additional educators.

The Lesson B took place in a normal school classroom with 45 learners seated at the desks in the classroom. The desks were arranged in groups with approximately five learners seated at each group of desks. The classroom arrangement for the Lesson B is shown in figure 13.

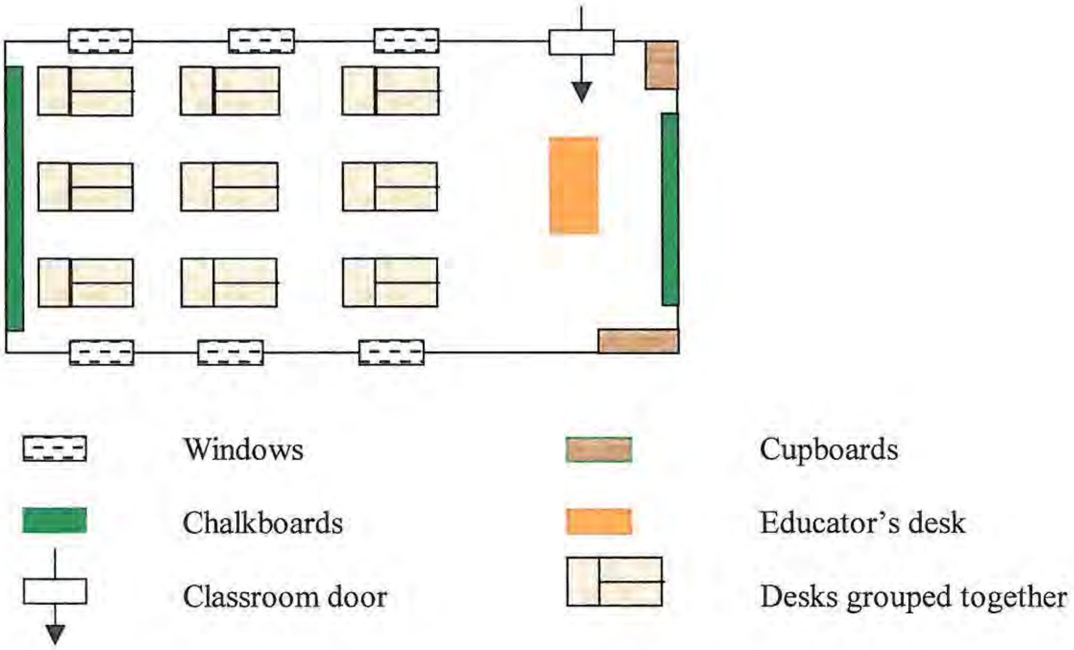


Figure 13. The classroom arrangement for Lesson B

The requirements in Curriculum 2005 and an OBE philosophy served to outline the educational policy that guided the implementation of the two Technology lessons in the school context. Both educators told the learners what the 'object' of the lesson would be at the start of the Technology lessons.

11.2 The 'object' of Lesson A and Lesson B

Educator A told the learners that the 'object' of the Lesson A was to use the steps in the technological process like a technologist to solve the 'problem'. The 'problem' scenario posed was the following:

Three villages in the Transkei region are damaged by a tornado. The roofs are the most affected. As a technologist what can you do to rescue this problem?

At the end of the thirty-minute lesson the learners had a ten-minute break (as indicated on the school time-table) and returned to the classroom. Educator A then told the learners to focus only on the 'possible solutions', thereby changing the 'object' from that at the start of the lesson. Educator A allowed the learners a short time to engage with the 'possible solutions' and again changed the 'object' when he asked the learners to select the 'best solution' and do 'working drawings'.

At the start of the Lesson B, Educator B asked the learners to 'brainstorm' around the term 'Technology'. He wrote the term 'Technology' on the chalkboard and recorded the learners contributions in a 'spidergram' as shown in Figure 14.

Figure 14. Brainstorming around 'Technology' in Lesson B

Educator B then chose 'problem-solving' as the 'object' of the Lesson B from the ideas generated by the learners. Educator B told the learners the following 'story' and asked them to identify the 'problem':

> The story is about three goats that live on one side of a river. On one side of the river there is a lot of green grass and in order for the goats to get to the green grass they have to cross a bridge over the river. However, a big scary animal lives under the bridge and every time the goats want to cross the river the scary animal hears them and chases them away.
>
> Field Notes Technology Lesson B (28 February 2000)

Educator B later included 'design' in the 'object' of the lesson when he asked the learners to 'design' an appropriate artifact to solve the 'problem'.

The 'object' of both Lesson A and Lesson B was to solve the 'problem' posed by Educator A and Educator B in the respective 'problem scenarios' which were explicitly stated at the start of the respective lessons. The 'problem scenario' posed by Educator A suggested that the 'problem' related to the South African context within the theme of 'housing' (S.A. DoE 1997g:8) although this was not explicitly stated by Educator A in Lesson A. The 'problem scenario' posed by Educator B did not relate to any topic suggested in the Senior Phase Technology document (S.A. DoE 1997g:8). The 'problem' that the educators posed suggested that the educators wanted the learners to achieve the critical cross-field outcome to identify and solve problems using creative and critical thinking (S.A. DoE 1997b:16).

The ability to solve problems "is fundamental to the acquisition of technological literacy" (S.A. DoE 1997g:8) and is a key attribute employers look for in the workplace in a rapidly changing technological society. People with problem-solving skills are considered adaptable and effective in unpredictable situations according to Resnick, as cited in Biehler and Snowman (1991:424). One of the reasons for introducing Technology as a new learning area in Curriculum 2005 was to teach learners problem-solving skills so that they will be effective in the workplace and contribute to South Africa's economic survival in a global economy. The methods the educators employed to reach the 'object' of their lessons however were different and will be discussed in section 11.3.1.3 later in this chapter.

Contradictions in Lesson A and Lesson B arose as a result of Educator A and Educator B's actions when using the 'tools' at their disposal to achieve the 'object' of the respective Activity Systems.

11.3 The 'tool' element

Contradictions emerged within the 'tool' element in Lesson A and Lesson B concerning two issues namely, conceptual tools and equipment tools. These contradictions *mainly* concerned the educators' conceptual 'tools' however, where contradictions concerning the learners' conceptual 'tools' emerged, these are documented, where applicable. Whilst similar contradictions emerged across the Activity Systems, differences also emerged which will be documented.

11.3.1 The educators' conceptual 'tool' contradictions

Contradictions concerning the educators' conceptual 'tools' emerged across both Activity Systems concerning two issues: the suitability of the 'problem scenario' posed by the educators, and the planning and implementing of lessons in the respective Activity Systems.

11.3.1.1 'Problem scenario' contradictions

The contradictions that occurred with regard to the educators' conceptual 'tools' concerned the 'problem scenario' in each of the Activity Systems are shown in Table 27.

Table 27. A description of the 'problem scenario' contradictions in Lesson A and Lesson B

EDUCATORS' 'PROBLEM SCENARIO' CONTRADICTIONS	
Activity System	**Description**
Lesson A	1-The educator (subject) does not a pose a problem appropriate for Grade 7 learners (ECtool). 2-The educator (subject) does not give enough information (ECtool) for the learners to engage with the task in any meaningful way (LDOL).
Lesson B	1-The educator (subject) does not pose a problem appropriate for Grade 7 learners (ECtool) 2-The learners (subjects) are not able to engage with the problem (LDOL) since it is poorly conceptualised (ECtool)

The 'problem' scenarios posed by Educator A and Educator B were inappropriate for Grade 7 learners since they were not able to investigate the 'problem' based on "detailed, logical and articulate work" using a variety of "methods, devices and processes" as required in the Senior Phase for Technology (S.A. DoE 1997g:8). Since both educators may not have adequately conceptualised 'problem-solving' at the FDE level (as discussed in Chapter 8 section 8.1.5) they may not have had the conceptual 'tools' to identify a suitable problem-solving 'scenario' for Grade 7 learners.

The 'problem scenarios' posed by Educator A and Educator B were not appropriate [see Lesson A contradiction 1 and Lesson B contradiction 1] since the 'problem' could not be solved by Grade 7 learners. While the Technology content covered in the Senior Phase should be less contextualised than the previous two phases, the scope of these particular 'problem scenarios' was too abstract and could not be investigated or researched in a concrete way by Grade 7 learners.

Secondary contradictions emerged in both lessons since Educator A and Educator B did not give enough information when stating the 'problem scenario' for the learners to engage with the 'problem' in any meaningful way since it was beyond their realm of experience [see Lesson A contradiction 2 and Lesson B contradiction 2]. The 'object' of Lesson A and Lesson B thus lacked practical possibilities and became an abstract exercise that did not engage the learners in a meaningful problem-solving context that the learners could solve when applying the steps in the technological process. The scenarios therefore complemented the "mental functioning" approach to Technology referred to by Olson (1997:384) and lacked a 'skills' and 'socio-cultural' perspective suggested in Curriculum 2005 for the Technology learning area (S.A. DoE 1997h:14).

Other contradictions that emerged in both Activity Systems concerned the 'planning and implementation' of the respective Technology lessons.

11.3.1.2 'Planning and implementation' contradictions

Contradictions concerning different 'elements' arose concerning the 'planning and implementation' of the lessons in relation to the 'object' in both Lesson A and Lesson B. These contradictions are shown in Table 28.

Table 28. A description of the 'planning and implementation' contradictions in Lesson A and Lesson B

EDUCATORS' 'PLANNING AND IMPLEMENTATION' CONTRADICTIONS	
Activity System	**Description**
Lesson A	14- The educator (subject) does not abide by the timetable (Stool) to complete the technological task (Erule) 16-The educator (subject) underestimates how long (Erule) it will take the learners to brainstorm their ideas so the educator changes the 'goal' to one of the steps - "possible solutions" 42-The educator (subject) does not plan the lesson effectively for the time available (ECtool)
Lesson B	5-The educator (subject) is unrealistic to suggest one minute for the discussion (Erule) and has to adjust the time so that the learners can complete the task 25-The educator (subject) does not plan his lesson effectively (ECtool) and there is not enough time to complete the tasks during the lesson

Primary contradictions arose in Lesson A when Educator A underestimated how long the learners would take to brainstorm their ideas [see Lesson A contradiction 16]. Educator A tried to cover too many concepts in three half-hour lessons without adequate explanation and due consideration for what outcomes could be achieved and assessed in this period of time [see Lesson A contradiction 42]. As a result of poor planning a secondary contradiction in Lesson A emerged when Educator A did not abide by the timetable to complete the lesson [see Lesson A contradiction 14].

Contradictions also emerged in Lesson B when Educator B suggested to the learners that they had 'one minute' to discuss the 'solutions' to the problem in their groups. Educator B then had to adjust the time so that the learners could complete the task [see Lesson B contradiction 5]. Another contradiction emerged when Educator B planned too many tasks for a double lesson, which the learners could not complete [see Lesson B contradiction 25]. Educator B then hastily told the learners to complete the 'design' task for homework without giving the learners the assessment criteria for their 'designs' as required in OBE. Neither educator was able to effectively facilitate the students' learning experience since they had not adequately conceptualised how much time was required to implement the tasks.

OBE requires flexible time frames to allow learners to work at their own pace (S.A. DoE 1997b:7). However given the present timetable system of half hour periods with a maximum of a double period at both School A and School B this was not possible. Until the system changes, learners will find it difficult to complete the tasks in the time allocated on the timetable. The inadequate conceptualisation of OBE lesson planning at the FDE level (as discussed in Chapter 8 section 8.1.2) may have manifest in poor planning at classroom level since the educators tried to accomplish too much in one lesson without taking the constraints of the timetable and the learners' level of expertise into consideration. Both Educator A and Educator B needed to plan a series of lessons over a period of time with clear outcomes to mediate the learners' understanding of Technology in the respective Activity Systems.

Differences in contradictions emerged in Lesson A and Lesson B concerning the methods Educator A and Educator B respectively instructed their learners to use to solve the 'problems' in the respective Activity Systems.

11.3.1.3 'Problem-solving' method contradictions

Differences emerged between the two lessons when Educator A adopted a technological process approach to problem-solving whilst Educator B adopted his own three-step approach to solving the problem. The contradictions for Lesson A and Lesson B are shown in Table 29.

Table 29. A description of the 'problem-solving' method contradictions in Lesson A and Lesson B

	EDUCATORS' 'PROBLEM-SOLVING' CONTRADICTIONS
Activity System	**Description**
Lesson A	4-The educator (subject) incorrectly refers to technological processes (Ectool) instead of '11 steps in the technological process' 28-The educator does not apply the steps in TE process in the 'correct' order (ECtool) and this does not facilitate learner's grasp of TE process
Lesson B	3-The educator does not adequately conceptualise 'problem solving' (ECtool) 4-The educator (subject) does not mediate (Erule) when the learners identify the problem as the "scary animal" (LCtool) 10-The educator (subject) does not challenge all the learners' solutions (Erule) that are inappropriate (LCtool) 11-The educator (subject) misinterprets "go around the river" and says that the goats will drown if they try to cross the river (ECtool) 13-The educator (subject) does not apply the steps in problem solving fully (ECtool) 15-The educator chooses the best solution (EDOL) for the learners without investigating pros and cons of possible solutions (ECtool)
	LEARNERS' 'PROBLEM-SOLVING' CONTRADICTIONS
Lesson A	10-The learners (subjects) cannot remember the 11 steps in the technological process (LCtool) and therefore cannot do the task 11-The educator (subject) does not teach the skills learners need, e.g. 'design' (EDOL) to carry out the steps in the TE process (LCtools) so the learners are not able to carry out the task 19-The learners' and educator's (subjects) understanding of the concept 'lightning' and 'tornado' reflect community beliefs (PComm) that are incongruous with scientific facts 21-The learners (subject) do not have the opportunity to think critically (LCtools) because the educator tells the learners what the solution is (EDOL) 22-The learners (subject) do not motivate their choice of solution (LDOL) as required (Erule) 23-The learners (subjects) have beliefs that have little scientific basis and this affects the judgments (LCtool) when solving the problem
Lesson B	9- The learners (subjects) offer solutions (LCtool) that do not solve the problem identified as the 'scary animal' 14-The learners (subjects) do not consider the possible solutions critically as suggested in problem solving (LCtool) 16-The educator (subject) does not teach the skills (EDOL) for the learners to 'design' (LCtool) 23-The learners (subjects) design inappropriate "sponges" because they do not know what the hoof of a goat looks like (LCtool) 24-The educator (subject) does not tell the learners (EDOL) that their designs are inappropriate (LCtool)

Contradictions emerged in Lesson A when Educator A incorrectly referred to the eleven steps in the technological process as 'the eleven technological processes' [see Lesson contradiction 4] which is a primary contradiction in relation to the 'object' of Lesson A since 'eleven technological processes' do not exist in Technology. Referring to the technological process incorrectly indicated that Educator A may not have adequately conceptualised Technology as a learning area specialist at the FDE level and did not have the conceptual 'tools' to mediate the learner's understanding of the technological concept at the school level.

Although the learners had applied the technological process to solve a similar problem in a previous lesson, they had not yet internalised the concepts since they could not remember the eleven steps in the technological process and therefore could not apply the steps as a 'tool' to solve the 'problem' [see Lesson A contradiction 10]. When Educator A realized that the learners did not remember the steps in the technological process he attempted to resolve the contradiction by writing the steps in the technological process on the chalkboard. While Educator A may have resolved the contradiction in the short term, his actions did not assist the learners to remember the steps in the technological process as 'tools' in the long term.

A primary contradiction emerged when Educator A did not apply all the steps in the technological process to solve the 'problem' [see Lesson A contradiction 28]. When the learners returned after the ten-minute break, Educator A asked the learners to report back in their groups on their 'possible solutions' which is the fifth step in the technological process. Educator A did not first engage the learners in the first four steps of the technological process namely, analyse the situation, write a brief, carry out research and write a specification before focusing on the 'possible solutions'. Dreyfus and Dreyfus, as cited in Engeström (1987:216) argue that as one becomes an 'expert' adherence to procedures disappears and sensitivities to one's context begin to operate, allowing one to drop certain steps or advance to particular steps. Whilst it may have been advantageous for Educator A to show flexibility by not following the steps in the technological process rigidly, it may have been necessary to show less flexibility in the early stages of learning so that the learners internalised all the steps first, before flexibility emerged.

In addition, contradictions emerged in Lesson A when the learners' 'cultural' beliefs concerning 'tornados' and 'lightening' influenced their judgments when brainstorming 'possible solutions' to the 'problem' [see Lesson A contradiction 23] as illustrated in the field note extract below:

> The educator scolds one of the boys who is talking while he [the educator] is talking. The educator says "Since you were talking what is your solution?". The boy stands up and struggles to say in English "To build new roofs". The boy sits down. The educator writes his comment on the chalkboard. The educator asks another group [the educator does not ask the groups to volunteer but points to the group]. A girl stands up and very quietly says, "to build strong roofs and houses". The educator says, "So you not only want to build new roofs but they must be strong". The learner says, "Yes" and sits down. The educator writes this solution on the chalkboard. The educator then asks another group and a girl stands up and says in a confident voice "Build new roofs that are dark [in colour]. She goes on to explain that roofs attract tornados if they are bright. The educator says, "Dark? Quite interesting. I would not have thought of that". The girl then explains that if you put motorcar tyres on top of the roofs then they [the roofs] will not attract the tornado. The educator says, "Are you not confusing a tornado with lightening?" The girl does not know what to say and sits down. The rest of the learners do not comment. Another group report back that they will "put big stones on the roof". The educator says that their solution is similar to the previous group's solution.
>
> Field Notes Technology Lesson A (28 March 2001)

The 'possible solutions' offered by the learners reflected rural communities' solutions to this 'problem' and the learners' understanding of 'tornado' further reflected the communities' beliefs that 'dark roofs' prevented tornados from striking the roofs [see Lesson A contradiction 19]. In addition, the learners' responses illustrate concrete 'solutions' to the 'problem', indicating that the learners may not yet have developed abstract thinking. Learners in the Senior Phase are required to reason more independently of concrete materials and experiences during the three year Senior Phase from Grade 7 to Grade 9. However, this lesson took place within the first three months of the learners entering Grade 7 and the learners may not yet have had the opportunity to shift from concrete to abstract thinking. Failure to demonstrate abstract thinking in this particular incident however may not be indicative of the absence of abstract thinking or the inability of a particular learner to think abstractly.

Once the learners had shared their 'possible solutions' with the rest of the groups, Educator A asked the learners to select the 'best solution' and to motivate their choice. A secondary contradiction arose when the learners could not motivate their choice of 'solution' as requested by the educator [see Lesson A contradiction 22]. The following extract shows that the learners were not able to adequately motivate their choice of 'best solution' since they had not adequately conceptualised the 'problem':

> A boy in the front of the class stands up and says, "Build strong roofs with support so that the tornado will not damage the roof". Another boy puts up his hand and suggests that the roofs must also be made of "dark colours so that the tornado doesn't think that it is a roof". A girl in another group suggests that the solution is to build new houses with dark roofs. The educator explains that if the houses are still standing then they must be strong so it would be a waste of money to build a whole new house when only the roof is affected. The educator then says "What kind of new roofs? If the roof is too high then it will catch the wind. You have to build a strong roof that is flat".
>
> Field Notes Technology Lesson A (28 March 2001)

Educator A did not encourage the learners' critical reflection of the 'solutions' since he accepted most of the 'solutions' that the groups provided without further comment. A secondary contradiction emerged when Educator A told the learners what the 'best solution' to the 'problem' was [see Lesson A contradiction 21]. By providing the learners with the 'best solution', the educator conceived of the 'problem' as a well-structured problem with one 'correct' solution, when in fact the 'problem' was an ill-structured problem with multiple solutions. Educator A did not give the learners the opportunity to use creative and critical thinking to provide multiple solutions to the 'problem' and may have failed to develop their understanding of the technological process as a 'tool' to solve problems with multiple solutions as required in OBE (S.A. DoE 1997g:8 and S.A. DoE 1997b:16).

Interestingly, Educator A submitted the same 'problem scenario' as his 'best work' in his portfolio in the FDE to demonstrate his understanding of the technological process [see Appendix EE for Educator A's 'best work']. The educator wrote in his portfolio that his 'preferred solution' was "Building a more balanced flat roof with triangulation helping to balance the roof. It must be reliable and convenient to count *[sic]* against tornados and thunderstorms" (FDE student portfolio 2000). The educator therefore had an idea in mind how he wanted the learners to solve the 'problem' in the 'problem scenario' and steered the learners towards his 'solution'. Educator A did not effectively develop the learners' understanding of problem-solving since he did not allow the learners to use the steps in the technological process as a 'tool' to find their own solutions to the problem.

A primary contradiction emerged in Lesson B when Educator B did not adequately conceptualise 'problem-solving' at Grade 7 level [see Lesson B contradiction 3]. Educator B never mentioned the technological process and adopted his own three-step approach to problem-solving [see Lesson B contradiction 13] unlike the five-step problem-solving process to solve most problems, suggested by Biehler and Snowman (1991:444-451). A number of contradictions arose as a result of Educator B's failure to apply the steps in the technological process to 'problem-solving' that manifest in different ways.

Firstly, a secondary contradiction occurred when Educator B accepted all the learners' suggestions without further comment when they attempted to identify the 'problem' [see Lesson B contradiction 4]. The different groups identified the problem as follows:

- the goats are afraid of the scary animal (x4)
- the animal living under the bridge
- the hoofs of the animals [goats]
- the animals [goats] make a noise when crossing the bridge (x2)

Field Notes Technology Lesson B (28 February 2001)

Educator B did not explore the 'problem' further and did not clarify what the 'problem' was before asking the learners to suggest 'possible solutions'.

Secondly, a secondary contradiction occurred in Lesson B when Educator B again accepted all the learners' suggestions of 'possible solutions' even though they were not appropriate given that most of the learners identified the 'scary animal' as the 'problem' [see Lesson B contradiction 10]. The groups suggested the following 'possible solutions' to the 'problem':

- one goat must cross the bridge at a time
- the goats to walk slowly over the bridge
- the goats must cheat the animal. The educator asks the group to explain what they mean. The learner reporting back appeals to his group to explain and a girl says that the goats must trick the animal so that he will go away from under the bridge and then the goats will be able to cross the bridge
- making another bridge far away from the first bridge so that the 'scary animal' will not bother the goats
- making a bridge that is much higher than the present bridge so that the animal cannot hear the goats when they cross the bridge
- the goats must go around the river. The educator comments that the goats cannot do this because the goats will drown if they try to swim across the river.
- the goats put sponges on their feet
- grass is put on the bridge to lessen the noise and the goats must walk slowly across the bridge.

Field Notes Technology Lesson B (28 February 2001)

Educator B's actions created a primary contradiction in Lesson B when he failed to critically evaluate the students' responses except to tell the learners that the goats will drown if they try to cross the river [see Lesson B contradiction 11]. Educator B may have misinterpreted "the goats must go around the river" creating a secondary contradiction since he did not ask the learners to clarify what they meant by "go around the river".

In addition, the fact that Educator B did not first clarify what the 'problem' was in Lesson B meant that the learners offered 'possible solutions' to solve the 'problem' as they interpreted it [see Lesson B contradiction 9]. A further primary contradiction occurred when the learners did not consider their 'possible solution' critically as required to solve a problem effectively [see Lesson B contradiction 14]. Since Educator B seemed satisfied with a variety of responses from the learners, this suggested that Educator B considered the problem to be an ill-structured problem with multiple solutions. Educator B however decided on the 'best solution' for the learners and circled the response "goats put sponges on their feet" which indicated that he conceptualised the 'problem' as a well-defined problem with only one 'solution' [see Lesson B contradiction 15]. Educator B failed to use the opportunity to develop the learners' critical thinking skills since he chose the 'solution' for the learners without allowing the learners to grapple with the 'pros' and 'cons' of each solution so that they could come up with their own 'solution' as required in OBE (S.A. DoE 1997b:7). Failure to adequately develop problem-solving skills at the FDE level (see Chapter 8 section 8.1.5) may have meant that the educators were not able to develop the learners' problem-solving skills in the school context.

In addition to problem-solving, both Educator A and Educator B required the learners to 'design' an artifact to solve the 'problem'. The learners in Lesson A were required to 'design' a 'flat' roof in their groups to solve the 'problem'. A secondary contradiction emerged when Educator A did not teach 'skills' like 'investigate', 'research' and 'design' in the technological process [see Lesson A contradiction 11]. Figure 15 shows three of the groups' 'flat' roof designs and demonstrates the learners' inadequate conceptualisation of 'design' and a 'flat' roof as articulated by Educator A (see section 11.3.1.4 in this chapter).

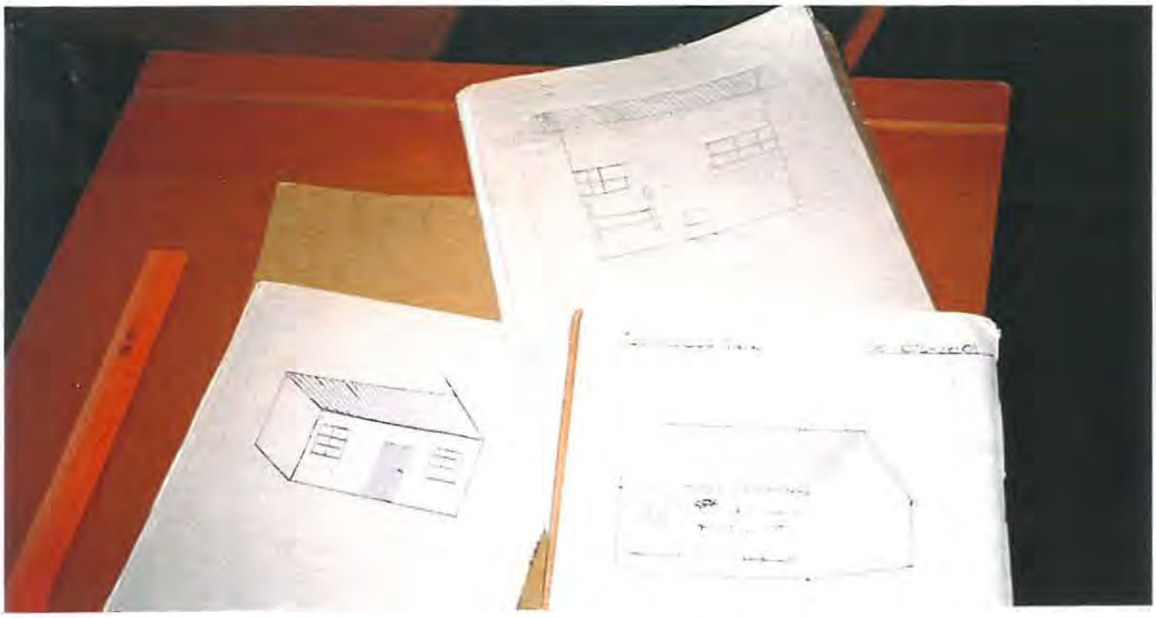


Figure 15. Examples of the learners' 'flat' roof designs in Lesson A

Educator B asked the learners to 'design' the 'sponges' for the goats' hoofs which resulted in a secondary contradictions since Educator B did not teach the 'skills' required to 'design' the 'sponges' [see Lesson B contradiction 16]. Educator B told the learners that 'design' means 'draw' which is a simplistic interpretation of the concept. A primary contradiction emerged when the learners 'designed' inappropriately shaped 'sponges' since they did not know what a goat's hoof looked like and were not able to investigate the shape during Lesson B [see Lesson B contradiction 23]. A further secondary contradiction arose when Educator B failed to tell the learners that their 'designs' or 'drawings' were inappropriate since the shape of the 'sponges' did not resemble that of a goat's hoof [see Lesson B contradiction 24].

Whilst the learners in Lesson A and Lesson B were required to complete a 'design' task, neither Educator A nor Educator B taught 'design' skills to the learners probably since the educators had not adequately conceptualised 'design' at the FDE level (as discussed in Chapter 8 section 8.1.4). While Educator B conceptualised 'design' as 'drawing' both educators relied on the implicit understanding of 'design' and allowed the learners to do the 'design' tasks according to their own understanding of 'design' without any constructive criticism or formative feedback.

The learners' conceptual understanding of 'design' and level of skill in both the lessons did not meet the required level of expertise suggested by the performance indicators in the Senior Phase for developing a design. The learners were expected to:

- apply graphic techniques in a variety of media and methods of inquiry (e.g. free hand and instrument drawing including 2D and 3D)
- detail the stages to be followed in making the design (include tools and equipment to be used)

S.A. DoE (1997g:9)

'Design' is one of the steps in the technological process that is fundamental to acquiring technological literacy (S.A. DoE 1997g:8) to meet the requirements of educational policy that will afford learners the opportunity to play an important role in the workplace. Unfortunately the learners were not able to demonstrate an adequate understanding of 'design' when solving the respective 'problems' by "designing, developing and evaluating solutions" (S.A. DoE 1997g:8). As a result, the learners will probably not be able meet the educational policy expectations in the workplace in a technologically advanced society.

Differences in contradictions also emerged between Lesson A and Lesson B concerning the issue of terminology in the respective Activity Systems.

11.3.1.4 'Terminology' contradictions

Contradictions concerning terminology only emerged in Lesson A since Educator B did not use terminology of a technological or scientific nature. The contradictions in Lesson A are presented in Table 30.

Table 30. A description of the 'terminology' contradictions in Lesson A

EDUCATOR A'S 'TERMINOLOGY' CONTRADICTIONS	
Activity System	**Description**
Lesson A	24-The educator (subject) refers to 'pitch' of the roof (ECtool) without adequate explanation 25-The educator (subject) refers to 'flat roof' (ECtool) without adequate explanation 26-The educator (subject) refers to 'strong roof' (ECtool) without adequate explanation 27-The educator (subject) refers to 'research' (ECtool) without adequate understanding and explanation 29-The educator (subject) refers to the concept 'flat roof' (ECtool) without adequate explanation 30-The educator (subject) refers to the concept 'pitch' (ECtool) without adequate explanation 31-The educator (subject) refers to the concept 'strong roof' (ECtool) without adequate explanation 32-The educator (subject) refers to the concept 'prevailing wind' (ECtool) without adequate explanation 33-The educator (subject) refers to the concept 'triangulation' (ECtool) without adequate explanation 34-The educator (subject) refers to the concept '2 D drawing' (ECtool) without adequate explanation 35-The educator (subject) refers to the concept '3 D drawing' (ECtool) without adequate explanation 36-The educator (subject) refers to the concepts 'truss' (ECtool) without adequate explanation 37-The educator (subject) refers to the concept 'working drawing' (ECtool) without adequate explanation

Having provided the learners with the 'best solution' to the problem, Educator A then told the learners that the next step in the technological process was to do 'research'. 'Research' precedes the steps to find 'possible solutions' and select the 'best solution' in the technological process. Without adequate 'research' appropriate solutions could not be reached. Primary contradictions were created by Educator A's actions since he had not adequately understood the concepts and terminology at FDE level (as discussed in Chapter 8 section 8.1.1). Educator A explained that 'research' [see Lesson A contradiction 27] entailed finding out about the 'prevailing wind' [see Lesson A contradiction 32] so that "you will then know in which direction the roof should be positioned so as not to catch the wind" (Field Notes Technology Lesson A 28 March 2001).

Educator A's explanation was inadequate to develop the learners' understanding of 'research' for three reasons. Firstly, 'research' is an abstract concept that needed to be carried out in a concrete way at Grade 7 level to give the learners the opportunity to internalise the concept and enable them to use 'research' as a 'tool' when solving technological problems in the future. Secondly, Educator A's understanding of 'research' in the technological process was inadequate since it had to be carried out first before an informed decision on the 'possible solutions' or 'best solution' could be made. Thirdly, Educator A decided for the learners what needed to be 'researched' instead of allowing the learners to explore for themselves which aspects of the 'problem' had to be 'researched' in order for them to conceptualise the 'problem'.

In addition, a number of primary contradictions arose as a result of Educator A referring to a host of concepts without adequate explanation [see Lesson A contradictions 24, 25, 26, 29, 30, 31,33, 34, 35, 36 and 37]. Educator A was not only unaware of the conceptual 'tools' that he was using, he also had an inaccurate understanding of some of the concepts and was therefore unable to adequately develop the learners' understanding of these concepts. For example, Educator A did not accurately conceptualise a 'flat' roof since he described a 'flat' roof as being strengthened through 'triangulation' and then diagrammatically illustrated 'triangulation' in a 'pitched' roof as shown in Figure 16.

Figure 16. Educator A's illustration of 'triangulation' in a 'flat' roof

The learners were not able to use the concepts that Educator A used as 'tools' to develop their understanding of the technological process. The learners relied instead on their general knowledge to provide 'solutions' for the 'problem' and not on a well thought through 'investigation' involving the eleven steps in the technological process to successfully solve 'the problem'.

Educator B on the other hand used no specialist terminology in Lesson B and even perpetuated the learners' colloquial English usage of 'sponges' to refer to the artifacts that the learners were required to 'design' to solve the 'problem'. Both Educator A and Educator B failed to develop the learners' understanding of Technology, Science and Mathematics concepts as was expected from a Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22). As a result the learners may not be able to develop an adequate understanding of Technology at the classroom level to meet economic imperatives as Curriculum 2005 intended.

Another difference in the contradictions that emerged between Lesson A and Lesson B concerned the issue of 'assessment'.

11.3.1.5 'Assessment' contradictions

Contradictions in relation to 'assessment' only emerged in Lesson A and are shown in Table 31.

Table 31. A description of the 'assessment' contradictions in Lesson A

EDUCATOR A'S 'ASSESSMENT' CONTRADICTIONS	
Activity System	**Description**
Lesson A	39-The educator (subject) does not align the assessment criteria (Erule) with the concepts he emphasised in the lesson (ECtool)

A secondary contradiction emerged when Educator A did not align the assessment criteria with the concepts that he emphasised in the lesson [see Lesson A contradiction 39]. The 'object' of Lesson A was to solve the 'problem' and Educator A's solution to the 'problem' was to design a 'strong', 'flat' roof taking into consideration the direction of the wind. The assessment criteria for the design of the strong, flat roof however was as follows:

Accuracy of measurement	8
Neatness	6
Layout and design	6
TOTAL MARK	20

These assessment criteria were not relevant to the solution for four reasons. Firstly, since the learners could not 'investigate' the roofs they could not give accurate measurements of the roof or draw these to scale. Secondly, while neatness is a consideration when designing, its weighting of 30% of the total mark was too high when one considers that the most important aspect of the 'solution' was the 'design', which was given the same weighting. Thirdly, the 'design' of the strong, flat roof that was pivotal to the 'solution' was not given prominence since it was linked to the 'layout' in the assessment criteria. Lastly, the mark allocations for the different assessment criteria were not appropriate since the 'marks' did not alert the learner to the performance required for each of the assessment criteria.

Educator A attempted to meet the requirements of OBE in Lesson A by giving the learners the assessment criteria for the 'design' task at the time that the task was assigned. Unfortunately the assessment criteria were not aligned to the lesson content, and 'marks' instead of 'descriptions' to indicate performance were used in line with norm-referenced assessment as opposed to criterion-referenced assessment required in OBE (S.A. DoE 1997f:28). Educator B on the other hand did not give the learners in Lesson B any assessment criteria or the performance indicators by which their 'designs' would be assessed and therefore failed to implement outcomes-based assessment as suggested (S.A. DoE 1997f:28-35). The educators' inadequate conceptualisation of outcomes-based assessment at FDE level (as discussed in Chapter 8 section 8.1.2) may have meant that neither Educator A nor Educator B were able to implement outcomes-based assessment adequately in the school context.

Contradictions also emerged that concerned the learners' conceptual 'tools' in relation to the 'object' of both Activity Systems.

11.3.2 Learners' conceptual 'tool' contradictions

Contradictions emerged in Lesson A and Lesson B concerning the issue of 'language' shown in Table 32.

Table 32. A description of the learners' 'language' contradictions in Lesson A and Lesson B

LEARNERS' 'LANGUAGE' CONTRADICTIONS	
Activity System	**Description**
Lesson A	3-The learner (subject) replies to the question in Xhosa (LCtool) and not English (Erule) 9-The learners (subjects) write in English (Erule) and discuss in Xhosa (LCtool)
Lesson B	6-Learners (subjects) speak Xhosa in groups (LCtool) and not English (Erule) 8-The learners (subjects) write in English (Erule) and discuss in groups in Xhosa (LCtool)

After Educator A presented the learners with the 'problem scenario' he asked the learners if they knew what a 'tornado' was. The learners said they knew what a 'tornado' was and one learner gave his answer in Xhosa and not in English which is the medium of instruction, resulting in a secondary contradiction with the 'object' in Lesson A [see Lesson A contradiction 3]. As second language English speakers the learners did not have the language 'tools' to express themselves in English whereas they could adequately express themselves in Xhosa, their mother tongue.

The language of instruction at School B also resulted in secondary contradictions when the learners spoke Xhosa in their groups and not English as required in an English medium school [see Lesson B contradiction 6]. The learners therefore used their mother tongue as a 'tool' to clarify their understanding during the group discussions before using the English language as a 'tool' to record their deliberations to comply with the requirement of medium of instruction of the school.

Further secondary contradiction arose in Lesson A and Lesson B when the 'scribes' wrote their groups' deliberations in English whilst the group members discussed in Xhosa [see Lesson A contradiction 9 and Lesson B contradiction 8]. Neither Educator A nor Educator B dissuaded the learners from following this practice which meant that the learners were not encouraged to use English as a 'tool' to develop their understanding of Technology to meet the critical outcome to communicate effectively using English language skills in modes of oral and/or written presentations (S.A. DoE 1997b:16).

In both lessons the learners used the Xhosa language as a 'tool' to communicate with one another. The educators needed to facilitate the development of the learners' English language skills, not only as a cognitive 'tool' but also as a 'tool' to facilitate the acquisition of other conceptual 'tools'. Without adequate English language skills the learners may not be able to communicate effectively, use creative and critical thinking, identify and solve problems and analyse, organise and critically evaluate information at school level (S.A. DoE 1997b:16).

Contradictions also emerged concerning equipment 'tool' in relation to the 'object' of both the Activity Systems. These contradictions *mainly* emerged in relation to the learners' actions although where applicable, the educators' actions are documented.

11.3.3 Equipment 'tool' contradictions

Contradictions arose in both Lesson A and Lesson B concerning equipment 'tools' such as textbooks and stationery. The contradictions are shown in Table 33.

Table 33. A description of the equipment 'tool' contradictions in Lesson A and Lesson B

EDUCATORS' EQUIPEMENT 'TOOL' CONTRADICTIONS	
Activity System	**Description**
Lesson A	43-The educator (subject) does not have a textbook to use (EEtool)
Lesson B	21- The educator (subject) has a textbook (EEtool) but does not refer to it (EDOL)
LEARNERS' EQUIPMENT 'TOOL' CONTRADICTIONS	
Lesson A	6-The learners (subjects) do not have pens, pencils, rulers and erasers (LEtool) 7-The parents (PComm) cannot/do not supply pencils, pens and rulers and erasers (LEtool) 40-The learners (subjects) do not have Technology textbooks (LEtool) so the educator cannot refer to it 41-The Department of Education (DEComm) has not supplied the learners with Technology textbooks (LEtool)
Lesson B	18-The learners (subjects) do not have pencils and erasers (LEtool) 19-The learners (subjects) borrow equipment (LEtool) from other learners in other classes (SComm) 20-The parents (PComm) do not/cannot provide pens, pencils, erasers, rulers (LEtool)

The Department of Education did not supply School A with Technology textbooks [see Lesson A contradiction 41]. As a result, secondary contradictions arose when there was no textbook for Educator A or the learners' to use to reach the 'object' of Lesson A [see Lesson A contradictions 40 and 43 respectively].

A secondary contradiction also emerged in Lesson B concerning textbooks. The contradiction arose as a result of Educator B not referring to the textbook despite the Department of Education supplying the school and the learners with the relevant Technology textbook [see Lesson B contradiction 21]. Instead, Educator B relied on his own conceptual 'tools' without making use of the textbook as an additional 'tool' to aid the students' learning.

Further primary contradictions occurred when the learners in Lesson A and Lesson B were required to have pens, pencils, rulers and erasers with which to write and draw during the Technology lesson [see Lesson A contradiction 6 and Lesson B contradiction 18]. Since the parent community was too poor to supply the learners with the equipment a secondary contradiction emerged when the learners did not have the stationery that they required in the Technology lessons [see Lesson A contradiction 7 and Lesson B contradiction 20]. The learners in Lesson B attempted to resolve this contradiction by borrowing the necessary equipment from learners in other classes [see Lesson B contradiction 19]. Educator B supported this practice and allowed the learners to leave his classroom to find the equipment they needed.

There seemed to be a level of acceptance and understanding amongst the educators and learners of the socio-economic conditions that constrained the ability of learners to have the necessary equipment and therefore allowances were made. Unfortunately without the parents sharing the responsibility of their childrens' education as required in OBE (S.A. DoE 1997b:27) and without the learners taking responsibility for "organising and managing themselves and their activities" (S.A. DoE 1997b:16), learning may not be effective and the critical outcomes may not be achieved in the school context.

Contradictions also emerged across both Technology lessons with regard to the 'rule' element in relation to the 'object' of the respective lessons.

11.4 The 'rule' element

Contradictions occurred in Lesson A and Lesson B when the learners did not abide by the educators' classroom 'rules' while in Lesson A the educator did not abide by the school 'rules'. The contradictions are shown in Table 34.

Table 34. A description of the classroom 'rule' contradictions in Lesson A and Lesson B.

EDUCATORS' 'RULE' CONTRADICTIONS	
Activity System	**Description**
Lesson A	13-The educator (subject) does not follow the timetable (Srule) and continues with the lesson after break for both classes
LEARNERS' 'RULE' CONTRADICTIONS	
Lesson A	17-The learners (subject) talk while the educator/learner is talking (Erule) and this prevents other learners from hearing what is being said
Lesson B	12- The learners (subjects) talk while other learners are talking (Erule) so the others cannot hear their ideas

A primary contradiction emerged when Educator A did not follow the timetable and engaged both Grade 7 classes for a single lesson before break and a double lesson after break [see Lesson A contradiction 13]. The fact that other classes were writing end-of-term tests may have contributed to this unusual practice since the lessons on the timetable at School A were either single or double lessons depending on the learning area and the Grade level. Alternatively, Educator A may have been responding to the researcher's presence and may not ordinarily have broken the school rule.

Another contradiction emerged in Lesson A when the learners talked in their groups while Educator A was explaining, thus preventing other learners from hearing what was being said [see Lesson A contradiction 17]. A similar contradiction occurred in Lesson B when the learners talked whilst other learners were talking [see Lesson B contradiction 12] despite Educator B reminding the learners that the classroom 'rule' stated that nobody should talk whilst another person is talking. The temptation to talk is unfortunately one of the drawbacks of having learners sitting in groups. Whilst working in groups may be a strategy to manage large classes, it is up to the educators to negotiate rules and establish consequences when the rules are breached.

In addition, it was incumbent on the educators to assist the learners' transition from relying on external discipline to developing internal discipline in the Senior Phase. Ineffective classroom management may have contributed to the learners not appreciating the importance of self-discipline and the educators may have contributed to learners not becoming responsible members of the class and broader school community (S.A. DoE 1997b:16).

Contradictions also emerged in relation to the division of labour 'element' in both Lesson A and Lesson B.

11.5 The 'division of labour' element

Contradictions emerged within the division of labour 'element' that concerned three issues namely, 'decision-making' in Lesson B and 'group work' and 'copying' in Lesson A and B. The contradictions are indicated in Table 35.

Table 35. A description of the 'division of labour' contradictions in Lesson A and Lesson B

EDUCATORS' 'DIVISION OF LABOUR' CONTRADICTIONS	
Activity System	**Description**
Lesson A	8-The educator (subject) only checks on the front few groups and does not check on all the groups (EDOL) so cannot be sure that all groups have elected scribe, leader, judge & reporter (Erule)
Lesson B	17-The educator (subject) over rules the learners' wishes (EDOL) and tells them to work individually instead of in a group
LEARNERS' 'DIVISION OF LABOUR' CONTRADICTIONS	
Lesson A	12-The learners (subject) do not learn by practicing the TE skills (LCtool) because they copy (Lrule) from their previous notes 15-The educator (subject) asks groups to elect leader and judge (Erule) but these roles are not put into action in the groups (LDOL) 20-Not all the groups (subjects) report back (LDOL) because they say they have similar solutions to those already given but the educator does not know this for sure 38-Only the one learner (subject) in the group (LDOL) designs the roof (LCtool) and not all the learners reach the goal
Lesson B	7-Some learners (subjects) are not prepared to share their ideas (LDOL) 22-The learners (subjects) are not using their creativity (LCtool) but rather copy each other's work (Lrule) and hence do not develop the skills necessary for designing

The contradictions within the division of labour 'element' concerned 'decision-making' in Lesson B. A primary contradiction emerged when Educator B over ruled the learners' wishes to work in groups whilst 'designing' the 'sponges' for the goats and insisted instead that the learners work individually [see Lesson B contradiction 17]. Educator B explained that his decision was based on the fact that "everyone must be a designer" and therefore it was important for each learner to 'design' his or her own 'solution'. The learners accepted Educator B's explanation and did as they were told.

Contradictions emerged in Lesson A and Lesson B concerning 'group work'. Educator A told each group of learners to elect a scribe, leader, judge and reporter in their groups, then only checked on the groups in the front of the classroom nearest the chalkboard to see if they had complied with this instruction [see Lesson A contradiction 8]. Secondary contradictions emerged when the learners did not implement all the roles during the group discussions [see Lesson A contradiction 15] and not all the learners were given the opportunity to carry out the task of 'designing' since only one learner in each group 'designed' the roof while the others observed [see Lesson A contradiction 38]. While all the learners sat in groups of six or seven at a group of desks in Lesson A, not all the groups reported back to the rest of the class since they said that their 'possible solutions' were similar to the 'solutions' given by the other groups [see Lesson A contradiction 20].

All the learners in Lesson B worked in groups and appeared to delegate tasks within the groups without Educator B mentioning the group roles during the lesson. Some of the learners in Lesson B were however, reluctant to share their ideas with the other members of their groups creating a primary contradiction [see Lesson B contradiction 7]. The groups were however willing to share their ideas with the other groups in the class during the plenary session.

Both Educator A and Educator B used 'group work' as a strategy during their lessons as suggested in OBE (S.A. DoE 1997b:7) which suggested that they wanted the learners to demonstrate the critical cross-field outcome "work effectively with others in a group" (S.A. DoE 1997b:16). While both Educator A and Educator B used 'group work' as a strategy neither educators taught the skills required to work effectively in groups. Neither did they consider the importance of explicitly developing social skills like active listening, giving constructive feedback to group members, conflict resolution and group accountability that needed to be taught if the learners were to demonstrate the ability to work collaboratively in groups. The educators did not encourage the development of writing skills since in both Technology lessons only the 'scribe' in each group was required to write. The Technology lessons were based on discussion and oral speech. Writing is not the same as speech since it requires higher mental functioning (Bodrova and Leong 1996:102). Being able to verbalise one's thinking in speech is therefore not the same as having to be explicit about what one means whilst writing. Unfortunately, these practices may have contributed to the learners not being able to communicate effectively in written presentations (S.A. DoE 1997b:16).

Contradictions also emerged in Lesson A when the learners copied their notes from a previous lesson context [see Lesson A contradiction 12]. The learners in Lesson A had not sufficiently conceptualised the 'problem' or the steps in the technological process to realise that the two 'problems' were not identical and hence the 'solution' given for the previous 'problem' was not appropriate for the 'problem' in Lesson A. Contradictions also emerged in Lesson B when the learners copied their peers' designs [see Lesson B contradiction 22]. By copying their peers the learners did not develop the necessary design 'skills' to solve technological problems. Neither Educator A nor Educator B showed any concern for such students' actions. Unfortunately it seemed that the educators did not view copying as a punishable 'offence' which is problematic, given that copying defeats the purpose of engaging in the task and goes against the principles of OBE that requires educators to instill values and attitudes like honesty as part of being a responsible citizen in a democratic society (S.A. DoE 1997b:16).

The findings from the Technology lessons in the school context have been presented and discussed in this chapter to provide insights into the implementation of educational policy in the classroom. In the next chapter, conclusions and recommendations are drawn from the research findings.

Chapter 12 Conclusions and Recommendations

In this chapter conclusions are drawn from the research findings presented in the previous chapters concerning the implementation of the FDE and the Technology lessons in the school context. The conclusions will be discussed in relation to educational policy presented in Chapter 2 and what the research revealed about the effectiveness of the FDE to re-educate educators and improve the educators' practice in the classroom in the school context.

Educational policy was executed at three levels: when the Further Diploma in Education (Technology) was conceptualised, during the implementation of the FDE, and in the classroom in the school context. The three levels are shown in Figure 17.

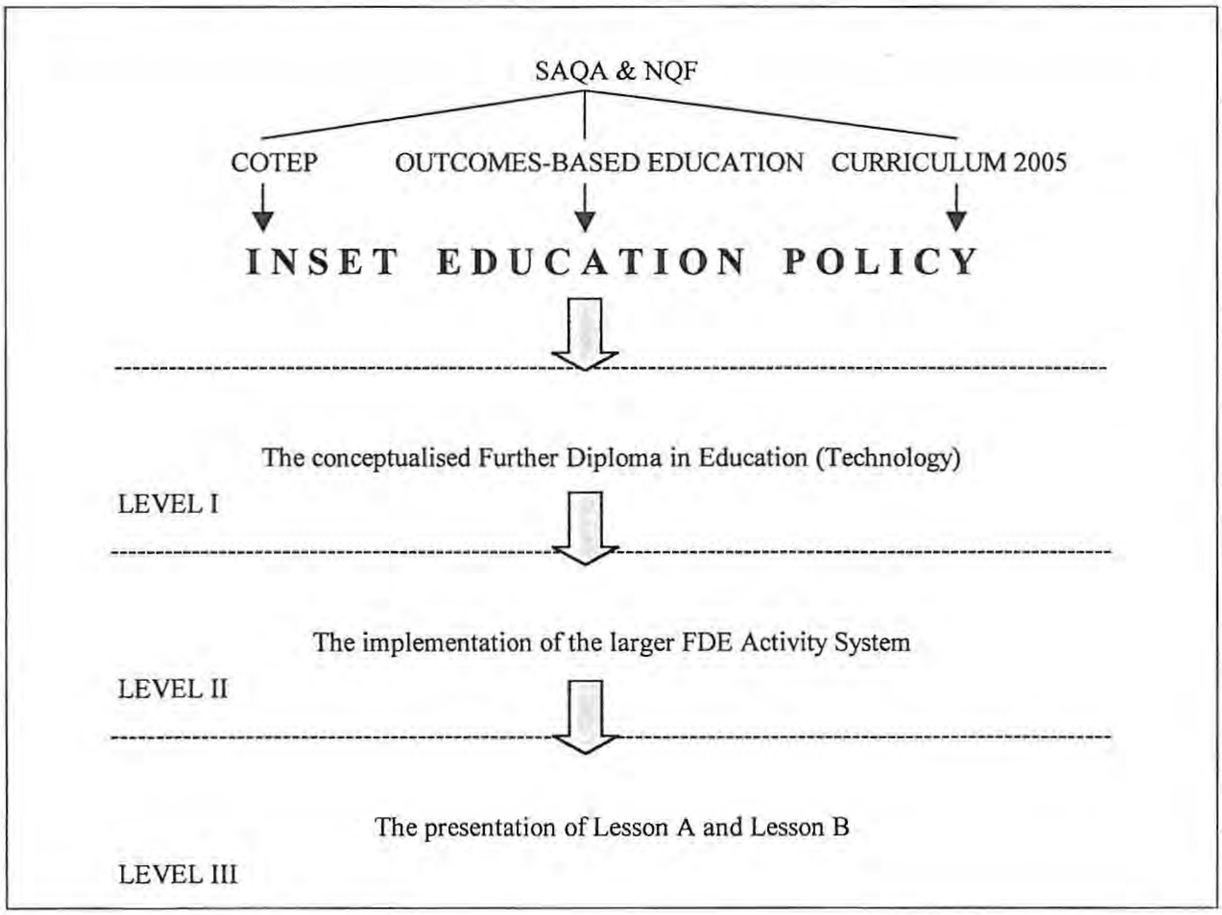


Figure 17. Educational policy implemented at three levels

The implementation of educational policy within a rapidly changing educational context was problematic. The findings of this research seem to suggest that educational policy (COTEP 1996) was adequately interpreted at the time that the FDE was conceptualised prior to educational policy being re-conceptualised as lifelong learning to improve professional practice, in keeping with transformation taking place in education in post-apartheid South Africa (see Chapter 3 section 3.3). When the 'new' competence-based educational policy in COTEP (1998) and S.A. Government Gazette (2000) in Chapter 2 section 2.5.2 and section 2.5.3 respectively, which aimed at redressing apartheid inequalities and meet the economic needs of South Africa in a global technological society, came into being the conceptualised FDE no longer fulfilled policy requirements. The FDE that was implemented during the period of this research between 1999-2000 was therefore aimed at achieving the aims of educational policy in COTEP (1996), as discussed in Chapter 2 section 2.5.1, and not the needs of educators teaching in an outcomes-based environment within the context of Curriculum 2005 (COTEP 1998 and S.A. Government Gazette 2000).

The mismatch between the 'new' competence-based educational policy and the 'old' content-driven educational policy on which the conceptualised FDE was based, gave rise to the 'objects' of the larger FDE Activity System not being compatible with the 'new' educational policy (see Chapter 7 sections 7.1 and 7.2). The findings of the research suggest that the mismatch between the 'new' educational policy and the 'object' of the larger FDE Activity System contributed to educational policy not being adequately implemented which in turn may have contributed to educational policy not being adequately translated into the classroom in the school context. These findings concur with the Review Committee on Curriculum 2005 that "there is little transfer of learning into the classroom" as a result of different levels of understanding during educator training (S.A. DoE 2000:21).

The findings suggest that educational policy was not adequately implemented in the FDE and in the classroom resulting in the inadequate conceptual and skill development with respect to:

- technological, scientific and mathematical concepts and terminology and the integration of Science and Mathematics concepts into the Technology learning area,

- developing designing, problem solving and writing skills
- OBE lesson planning and assessment, and
- the students' language difficulties.

In addition, the findings suggest that the implementation of educational policy in the FDE and the classroom was constrained by:

- the inadequate use and availability of resources,
- the organisational rules,
- the broader community, and
- the teaching and learning activities.

Each of these factors will be discussed in turn, starting with the conceptual and skills development.

12.1 Conceptual and skill development

12.1.1 Concepts and terminology

One of the aims of INSET educational policy (COTEP 1994, 1996, 1998 and S.A. Government Gazette 2000) is to re-educate qualified educators to teach in learning areas in which they were not originally qualified. The larger FDE Activity System aimed to re-educate educators in Technology, a new learning area in Curriculum 2005.

The University FDE syllabus (1998) was designed to develop the knowledge and skills to meet the requirement of a Technology learning area specialist. The findings of this research show that the students were unfamiliar with and had an inadequate understanding of concepts and terminology in the different Modules in the FDE in the following areas (see Chapter 8 section 8.1):

- in the Technology Module - 'capability task', different materials and wood products, the component parts of a hydraulic system, levers, velocity ratio and mechanical advantage in pulley drives, chain and sprocket drives and spurt gear drives, 'research' and referencing, 'design' and 'working drawing'.

- in the Science Module - 'Pascal', velocity ratio, mechanical advantage, moment and couple calculations, basic chemistry, molecular structure and the changing states of water.
- in the Mathematics Module - 'tangram' puzzle, equivalency, BODMAS, 'rounding off', 'recurring', units of measurement, 'base', 'perpendicular height' newtons, rotational frequency, calculating volume, velocity ratio, mechanical advantage, efficiency, fractions, area, and distinguishing between 'shapes' and 'patterns'.
- in the Education Module - OBE lesson planning, 'assessment', 'evaluation', 'governance', 'management' and 'research'.

Since the students did not adequately conceptualise the concepts and terminology in the different Modules they may not be able to demonstrate the role of Technology learning area specialists (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22). The research also shows that the students in the FDE contributed to their own inadequate conceptual understanding by not doing the homework and assignment tasks, by completing the homework and assignment tasks during lecture time, coming late for lecture sessions and disrupting lecture sessions by talking or having their cell phones on.

Since the students in the FDE had an inadequate understanding of many technological, scientific and mathematical concepts, they were not able to use and/or explain the concepts and terminology appropriately as Technology learning area specialists in the school context. The learners, in turn, were not able to grasp the following concepts (see Chapter 11 section 11.3.1.4):

- in Lesson A – 'research', 'pitch', 'flat' roof, 'strong' roof, 'prevailing' wind, 'triangulation', '2D' and '3D' drawing, 'truss' and 'working drawing' and 'design'.
- in Lesson B – apart from the concept 'design,' no technological, scientific or mathematical concepts and terminology were used. Instead, 'sponges' referred to the product to be 'designed' to solve the 'problem'.

Without an adequate understanding of the technological, scientific and mathematical concepts and terminology, the learners in the school context may not fulfill the promise of Technology in Curriculum 2005 - to apply their knowledge to meaningfully engage in a rapidly changing technological world and develop to be productive members of society by designing, realising and evaluating solutions to technological problems (S.A. DoE 1997h:10).

The research findings show that the students in the FDE did not *understand* and *apply* their knowledge in the different Modules (see Chapter 8 section 8.1.2). For example:

- in the Technology Module – the students could not fully understand and explain the scientific concepts of 'weight' and 'force', gravitational forces, 'input-output' hydraulic system and energy.
- in the Science Module – the students were not able to calculate 'surface area' and 'acceleration', which are mathematical concepts.
- in the Mathematics Module – the students were not able to calculate 'force' and 'gradient', which are scientific concepts.

In addition, whilst the students in the FDE knew that there was a difference between Technology, Science and Mathematics, they did not know which concepts belonged to each discipline and therefore could not integrate Science and Mathematics into the Technology learning area as suggested in Curriculum 2005 (S.A. DoE 1997h:26-27).

These findings suggest that since the educators did not adequately conceptualise Science and Mathematics concepts and terminology, they were not able to engage the learners in practical activities in the classroom to develop their conceptual understanding in the respective disciplines (see Chapter 11 section 11.3.1.4):

- In Lesson A – the educator used a host of technological, scientific and mathematical concepts and terminology that learners were not able to grasp in a lesson that was largely a cognitive exercise with little or no practical Science or Mathematics application.
- In Lesson B – the educator did not refer to any technological, scientific and mathematical concepts and terminology and as a result, the learners did not develop an understanding of Science or Mathematics and neither did they apply Science or Mathematics concepts and terminology in a practical way.

Whilst these research findings support the observation that a lack of curriculum content has created a disjointed approach to the study of Technology (Wicklein 1997:unpaged), the extent of the students' lack of knowledge due to past practices may unfortunately diminish the impact that Technology has on education in South Africa.

Technology in Curriculum 2005 is aimed at developing technological knowledge and skills through mastering 'technological capabilities', which involve developing optimum solutions to technological problems whilst designing, making and evaluating (S.A. DoE 1997h:12). Designing is one of the technological capabilities that was not adequately conceptualised in the FDE or in the classroom context.

12.1.2 Design skills

The research findings show that the students in the FDE did not adequately conceptualise 'research', 'design' and 'working drawing' (see Chapter 8 sections 8.1.3 and 8.1.4) - steps in the technological process to solve problems and satisfy needs and wants that are "the basis for all technological endeavour" in the Technology learning area (S.A. DoE 1997g:8). The reason for this may have been that there was too much emphasis placed on 'making' with too little emphasis on the cognitive aspects of 'research', 'design' and 'evaluation' in the practical tasks. Other factors contributing to the students' inadequate conceptualisation of 'design' in the technological process may have been that:

1. the students were not taught the principles of 'design',
2. the students were given 'designs' to 'make',
3. the students' were under-prepared with respect to fine motor co-ordination skills,
4. the students had insufficient practice in two 'design' tasks to develop their 'design' skills, and
5. time constraints may have contributed to 1, 2, 3 and 4 above.

Furthermore, the research findings show that since the students in the FDE did not adequately conceptualise 'research', 'design' and 'working drawing' in the technological process, they were not able to demonstrate the role of Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22) and translate technological 'skills' into the classroom (see Chapter 11 section 11.3.1.3):

- In Lesson A - instead of 'designing' a 'flat' roof, the learners sketched stylised pictures of houses with 'pitched' roofs.
- In Lesson B – the learners drew pictures of 'sponges' for goats' hoofs that did not resemble the shape of a goat's hoof.

Unfortunately, the DoE's hope that Technology will prepare school learners for entry into the workplace may not become a reality, since the aim of school learners acquiring the 'skills' to engage in a rapidly changing technological world through designing artifacts to solve technological problems was not realised.

Problem-solving was another 'skill' that was not adequately conceptualised in the FDE and in the classroom.

12.1.3 Problem-solving skills

The aim of Technology in Curriculum 2005 to teach problem-solving 'skills' arises from the belief that employees in a rapidly changing technological society require 'skills' in the work place that enable them to function in "complex environments" that are "characterised by ill-defined problems" (Westera 2001:75). The research findings indicate that most of the students failed to adequately conceptualise and were not able to solve well-structured and ill-structured problems in the FDE (see Chapter 8 section 8.1.5). The fact that many students had little prior knowledge of Science and Mathematics may have contributed to their inability to solve problems. In addition, the 'three-step' teaching strategy in the Mathematics Module may have contributed to the students' perception that all problems are well-structured problems with one 'correct' solution (see Chapter 10 section 10.2.1).

The students' inability to develop problem-solving 'skills' in the FDE may have contributed to educational policy not being adequately implemented in the classroom in the school context. The educators in the school context both had difficulty identifying a suitable 'problem scenario' for Grade 7 learners. The scenarios were inappropriate for Grade 7 learners since they were not relevant to the learners' real-life situation (S.A. DoE 1997b:7) and may have failed to support learners' attempts at solving real problems (S.A. DoE 1997h:28).

In addition, both educators in the school context viewed their respective problems as well-structured problems by insisting on one 'correct' solution and not as ill-structured problems with multiple solutions (see Chapter 11 section 11.3.1.3). The learners, therefore, may not have been able to discriminate between well- and ill-structured problems and may not develop the 'skill' to solve ill-structured problems. As a result the learners may not be adaptable and effective in the workplace as anticipated through the implementation of the Technology learning area in Curriculum 2005.

12.1.4 Writing skills

Developing writing skills is important for demonstrating the critical outcome to communicate effectively using language skills in written presentations (S.A. DoE 1997b:16). The research findings show that the students were not able to adequately demonstrate this outcome in the academic writing tasks in the FDE (see Chapter 8 section 8.1.6). The educators in the school context did not encourage the development of the learners' writing skills in the Technology lessons that were based on discussion and oral speech. Only the 'scribe' in each group was required to write down the groups' deliberations (see Chapter 11 section 11.3.2). Unfortunately, these practices may contribute to the learners not being able to communicate effectively in English in written presentations as suggested for the critical outcomes.

12.1.5 OBE lesson planning and OBE assessment

These research findings show that whilst the content of the Education Module in the University FDE syllabus (1998) was intended to be integrated into the Technology, Science and Mathematics Modules, this was not done explicitly or adequately. In addition, since the FDE had a content and not an outcomes-based focus, this may have contributed to the students' inadequate conceptualisation of OBE practices (see Chapter 8 section 8.1.2). Since the students did not adequately conceptualise OBE lesson planning and OBE assessment in the FDE, this may have meant that they were not able to apply their knowledge in the roles of interpreter and designer of learning programmes (COTEP 1998:73-74 and S.A. Government Gazette 2000:16-17) and assessor (S.A. Government Gazette 2000:21). These findings support those of the Review Committee on Curriculum

2005 "that greater attention needs to be given to assessment in teacher preparation for the new curriculum" (S.A. Government Gazette 2000:19).

An inadequate conceptualisation of OBE principles and practices in the FDE and the fact that changing one's practice is a process that takes time, may have contributed to the students not being able to adequately implement OBE lesson planning and OBE assessment in the classroom in the school context. Whilst both educators articulated the aim of their lesson, they failed to adequately plan the lessons to realise these aims (see Chapter 11 section 11.3.1.2). Both educators attempted to include too many tasks in the available lesson time. While OBE requires that learners are given time and assistance to achieve the desired outcome (S.A. DoE 1997b:18), given the present school timetable system, time constraints are likely to be problematic. Mindful of time constraints, the educators needed to plan a series of lessons with clear outcomes for each lesson culminating in reaching a larger outcome at the end of a series of lessons. In addition, OBE assessment was inadequately implemented and integrated in the Technology lessons (see Chapter 11 section 11.3.1.5). Without adequate assessment, the learners may not know what they need to learn and be able to do (S.A. DoE 1997b:17-18).

12.1.6 Language difficulties

Mastery of the language of instruction is of paramount importance because it facilitates the acquisition of other 'tools'. Difficulties with the language of instruction would thus contribute to the inadequate implementation of educational policy because conceptual understanding would not have been achieved. The research findings show that both the students and the learners spoke Xhosa, their mother tongue, in their groups whilst attempting to develop a conceptual understanding (see Chapter 8 section 8.1.1 and Chapter 11 section 11.3.2 respectively). Higher mental functions are built upon lower mental functions in a culturally specific way (Bodrova and Leong 1996:20). If the lower mental function is conceptualised in the home language and there is a lack of suitable vocabulary in the language of instruction, the higher mental function may not be expressed adequately, thus contributing to the failure of the students and learners to demonstrate the conceptual understanding and skills required to be technologically literate. The underlying OBE principle that the home language be maintained while providing access for the acquisition of other languages may perpetuate this constraint (S.A. DoE 1997b:22).

12.2 The use and availability of equipment

Adequate resources are considered an important part of providing teaching and learning support for the acquisition of knowledge, skills, values and attitudes (S.A. DoE 1997b:24). The research findings show that all the equipment that the students needed in the FDE was provided, except for stationery and a scientific calculator. Yet the students regularly failed to bring the equipment to the lecture sessions in all four Modules (see Chapter 8 section 8.2 and Chapter 9 section 9.2.2):

- In the Technology Module – the students did not bring cutting knives and mats, and the prescribed textbook to the lecture sessions.
- In the Science Module – the students did not bring their microchemistry science kits and accompanying notes, and scientific calculator.
- In the Mathematics Module – the student failed to bring their scientific calculators, prescribed textbook, and cutting mats and knives.
- In the Education Module – the students neglected to bring their 'journals' and the prescribed textbook.

The research suggests that the students' actions may have contributed to their inadequate conceptual and skills development since the equipment was intended to enhance their learning experience, yet it appeared as if they were content with sharing equipment with their peers. The sharing of equipment had a negative impact on the teaching and learning activities since students took longer than anticipated to complete the tasks thereby reducing the time for other activities. Waiting to share equipment also provided an opportunity for casual conversation that may have negatively affected the amount of work the students completed during a lecture session. Consequently, the students were under pressure to develop the conceptual and physical skills, given the additional time constraints, to demonstrate the role of Technology learning area specialists (COTEP 1998:79-80 and S.A. Government Gazette 2000:21).

A factor that may have contributed to the inadequate implementation of educational policy in the FDE with regards to equipment was the students' under-preparedness and inadequate conceptual understanding and physical skills in using the equipment. The findings show that while some students may have brought the equipment to the lecture session, they were not able to use the equipment. For example, most of the students could not use their scientific calculators. The students were also not able to use their pencils and rulers to measure accurately or use crayons and colouring in pens competently (see Chapter 8 section 8.1.3). Their competence in using these equipment 'tools' however did improve over time. Without adequate 'skills' to use the equipment, the students were not able to demonstrate the role of Technology learning area specialist (COTEP 1998:79:80 and S.A. Government Gazette 2000:21-22). Whilst the purpose of INSET is to re-educate qualified educators, the research findings indicate that time constraints may have made the task of developing the educators' knowledge and skills almost impossible in a two-year (part-time) FDE.

The educators in the school context also had to contend with learners with inadequately developed conceptual 'tools' and physical skills to use equipment like pencils and rulers in the 'design' task in the Technology lessons (see Chapter 11 section 11.3.3). Unfortunately, the educators were not aware that the learners' use of the equipment was inadequate and they did not take steps to remedy the situation. In addition, the research findings show that as in the FDE, some learners in the Technology lessons did not bring the basic stationery like pencils, rulers and erasers to school. The reason for this was that the 'parent' community, consisting mainly of pensioners, could not afford to pay for these resources.

Whilst textbooks are believed to be a cost-effective means of improving classroom practice, the research indicates that the Department of Education did not provide one school with Technology textbooks and one educator did not have a textbook to use. Whilst the other educator's school had been provided with Technology textbooks, he chose not to use the textbook. The Review Committee on Curriculum 2005 also found that there were educators who did not use the textbooks even though they had them in their possession (S. A. DoE 2000:68). It will be up to the Education Department and the parent community to provide the resources to ensure that Technology in Curriculum 2005 realises its promise. Lack of financial resources may however make this highly improbable. Without basic equipment, the implementation of Technology as a learning area will not be effective in developing the knowledge and skills to meet the economic needs of South Africa in a technological world as proposed in Curriculum 2005.

The research shows that the 'rules' in the FDE and the classroom had a constraining influence on the implementation of educational policy in the teaching and learning environment.

12.3 The organisational rules

The research indicates that institutional 'rules' such as the agreement between the NGO branch in City B and the University in City A may have constrained the implementation of educational policy in the FDE (see Chapter 9 section 9.1). The agreement that the FDE be administered by the University in City A, contributed to students not having access to library facilities on the University campus in City B which may have contributed to the students' inadequate development of academic writing and research skills. The agreement between the NGO branch in City B and the University in City A that student fees be paid to the NGO branch also contributed to the loss of lecture time. The research shows that the students may have contributed to administrative difficulties by not paying their fees timeously, and to the loss of contact time by not attending lectures to avoid being confronted about paying their fees.

At the lecture session level, the research findings show that the students contributed to the reduction of the number of contact hours by disregarding the lecture session rules (see Chapter 9 section 9.2.1). The students arrived late for lecture sessions, talked whilst the lecturer explained concepts and interrupted the lecture sessions when their cell phones rang. Most of the students' actions showed a total disregard for the values and attitudes embodied in the constitution, which the new educational policy aimed to instill. The students further compromised their chances of developing the knowledge and skills required to be competent Technology learning area specialists (COTEP 1998:79-80 and S.A. Government Gazette 2000:21) by not bringing the equipment that they needed to the lecture sessions, by not doing the homework and assignment tasks and/or by completing the homework and assignment tasks during lecture time.

The 'rules' in the school context that contributed to educational policy not being adequately implemented mainly involved the school timetable that only allowed for a maximum of a double lesson per learning area in any one day (see Chapter 11 section 11.4). A triple period in one of the Technology lessons (the educator did not follow the timetable) and a double period in the other Technology lesson was not long enough to accomplish what both educators had planned. The educators' expectations of what could be achieved in a triple/double lesson were however unrealistic since they had not adequately conceptualised OBE lesson planning in the FDE. Whilst OBE promotes flexible time frames in which learners are encouraged to work at their own pace, this research indicates that the present school timetable system may neither promote flexible time frames nor may it provide learners with the opportunity to work at their own pace.

12.4 The community involvement

The research findings show that whilst the community played a peripheral role in the teaching and learning activities in the FDE and the classroom, the community involvement may have constrained the teaching and learning activities in both the FDE and the school context. Poor administration may have contributed to the reduction in the number of contact hours and compromised access to the University campus in City B (see Chapter 9 section 9.1). A loss of contact hours may have contributed to the lecturers not having sufficient time to cover the content-laden University FDE syllabus (1998) and may have put undue pressure on the students to develop the knowledge and skills required to be a competent Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22).

Whilst the constraints of the community involvement at FDE level concerned administrative issues, the constraints of the community involvement in the school context concerned the availability of equipment (see Chapter 11 section 11.3.3). The parents in both schools were not financially able to provide the learners with the stationery that they needed whilst the Department of Education did not provide the Technology textbook required in the Technology lesson in one of the schools (see section 12.2). As a result, insufficient material resources may have constrained the teaching and learning activities in the classroom.

12.5 The teaching and learning activities

OBE advocates that learners should be given time and support to demonstrate clearly identified outcomes and multiple teaching and learning strategies and assessment strategies should be used to achieve these outcomes (S.A. DoE 1997b:17-18). The research shows that whilst the nature of Technology lends itself to active learning in an OBE teaching and learning environment, time pressures and the students' under-preparedness may have constrained the implementation of educational policy in the FDE (see Chapter 8). The students' under-preparedness meant that they were not able to complete the tasks within the time allocated in the FDE. The students however exacerbated the time constraints by arriving late for lecture sessions and not doing the homework and assignment tasks expected of them. It may however have been unrealistic, under the circumstances, to expect the students to develop the necessary knowledge and skills and still cover the content-laden University FDE syllabus (1998) within the constraints of a two-year, part-time programme.

The research findings show that in addition to the practical activities, other strategies were also implemented that may have constrained the teaching and learning activities in the FDE (see Chapter 10 section 10.2.1):

- in the Technology Module - the lecture method in conjunction with demonstrations was implemented to convey content knowledge.
- in the Science Module - the 'self discovery' and lecture method was implemented to convey Science content.
- in the Mathematics Module – the 'three-step' approach was adopted to teach problem-solving of well-structured mathematical problems that did not encourage critical thinking and ill-structured problem-solving.

Infrequent formative assessment may also have contributed to the above strategies constraining the students' learning in the FDE (see Chapter 10 section 10.3). The research shows that summative assessment in assignments was mainly used to assess the students' ability to apply their knowledge and skills. As a result, there may not have been a way of remedying the students' conceptual shortcomings before proceeding to the next topic in a content-focused University FDE syllabus (1998). This may have contributed to the students in the FDE relying on their peers for support particularly in the Science and Mathematics Modules.

The research shows that a peer tutoring arrangement was adopted in the FDE in part because the students sat in groups in most of the lecture sessions and because the lecturer encouraged it (see Chapter 10 section 10.2.1). Peer tutoring may however not have been appropriate since the students doing the tutoring may not have had sufficient knowledge to be considered 'experts'. This may have contributed to the inadequate conceptual understanding of the weaker students and may have perpetuated the inadequate conceptual understanding of the so-called 'experts'. The research findings also show that the students adopted inappropriate coping strategies such as copying each others work in the FDE, which may further have jeopardised their chances of adequately developing conceptual understanding and skills required to be a Technology learning area specialist (COTEP 1998:79-80 and S.A. Government Gazette 2000:21-22).

In the school context the research findings revealed that both educators adopted a 'group-work' strategy (see Chapter 11 section 11.5). However, the educators' inadequate understanding and implementation of group-work may have constrained the teaching and learning activity since not all the learners participated in the group discussions and not all the groups carried out the group roles. In addition, the research shows that one of the educators abandoned the 'group-work' strategy in favour of the lecture method whilst using a host of concepts and terminology in relation to 'design' that may also have constrained the students' learning. The findings show that the learners in the school context also resorted to copying their peers' work, although this was not perceived to be a transgression by either educator despite copying being dishonest and contrary to values and attitudes upheld by a democratic society.

The factors mentioned above point to four broad issues concerning the implementation of educational policy in this research.

Firstly, the research points to challenges in responding to rapid changes in educational policy. The rapidly changing educational context and the implementation of 'new' educational policies within a relatively short period of time, meant that the lecturers and the educators were not fully prepared for the changes that they were expected to make in their professional practice. Changing one's practice is a process that may take years to achieve. The lecturers and educators were caught in the transition between the 'old' content-driven approach and the 'new' outcomes-based approach, which may have contributed to educational policy not being adequately implemented.

Secondly, the findings point to the practical problems of translating policy into practice. The inability of the stakeholder institutions to respond to the rapid changes in educational policy made the 'top-down' approach to the implementation of policy problematic. Problems arose when educational policy was implemented through the FDE, which was conceptualised to meet the content-driven approach and not the outcomes-based approach to education. Equally problematic was the 'bottom-up' approach where educators in the school context were aware of the difficulties in implementing educational policy in their local contexts, which the lecturers may not have been familiar with, which may have led to educational policy not being adequately implemented in the school context. Inevitably both approaches occurred during the implementation of educational policy, however the two approaches did not articulate successfully.

Thirdly, this research points to a lack of resources in the FDE and in the school context constraining the implementation of educational policy. The students in the FDE did not bring the equipment that they needed to the lecture sessions and the educators and learners did not have the equipment that they needed to adequately implement educational policy in the school context. The availability of resources is linked to the fourth issue, namely the stakeholders' commitment to education.

Fourthly, the findings point to a lack of commitment to education on the part of the stakeholders. Some of the students in the FDE were more concerned about obtaining a certificate than re-skilling in the Technology learning area and showed their indifference by *inter alia,* not bringing the equipment that they needed or by arriving late for lecture sessions. The parent community did not support the learners by providing the stationery that they required and the Department of Education did not supply the Technology textbook that the educator and learners required in one of the schools.

12.6 Applicability

The aim of this research was not to generalise or enumerate frequency, but rather to provide sufficient detail about the context and the processes of the research to allow the reader to make judgments concerning the applicability of this research to other contexts.

This research indicates that there are areas that need to be focused on for educational policy to be effectively implemented in INSET and in the classroom.

12.7 Recommendations

To address the broader policy issues it is recommended that:

- the Department of Education provide funding for extended curriculum programmes for re-educating educators who may not be able to be re-educated through standard curriculum programmes;
- the Department of Education provide the necessary infrastructure and resources such as hand tools and materials, as well as textbooks, for schools to implement the Technology learning area effectively;
- the Department of Education make provision for families that cannot afford to provide the equipment needed by the learners;
- the district managers in the Department of Education provide educators with the necessary support to implement the Technology learning area; and
- the Governing Councils encourage the school community to be actively involved in and provide the necessary resources for the learners' education.

To address the inadequate conceptual and skills development in the FDE it is recommended that the lecturers:

- use the critical outcomes as a guide to develop specific outcomes for the four Modules in the FDE that fulfill policy requirements;
- use the specific outcomes to develop a curriculum where stakeholders seek to integrate the four Modules by identifying 'themes' that run across the Modules;
- develop the curriculum to focus on developing Science and Mathematical concepts and skills in the first year of study whilst the second year be devoted to developing Technological skills;

- develop the curriculum where the Education Module plays an integral role in the curriculum to develop the practice of Technology learning area specialists particularly in the area of OBE lesson planning and OBE assessment without neglecting the other educator roles and applied competences;
- implement the re-curriculated FDE to model OBE practice and focus on learning as opposed to teaching;
- develop and implement an extended curriculum for under-prepared students in Science and Mathematics and plan appropriate interventions in the curriculum to develop physical, language and writing skills. Additional support may address the students' under-preparedness and may result in students no longer having to rely on inappropriate coping skills.
- integrate formative assessment into the curriculum across all four Modules;
- reduce and revise the contents of the University FDE syllabus (1998) in the light of the critical outcomes and newly developed curriculum;
- make provision in the newly developed curriculum for instruction on using a scientific calculator;
- develop course guides detailing the course outcomes, lecture session content and assessment tasks and give the course guides to the students at the start of each year of study;
- emphasise the role of the textbook and other resource material in curriculum change and encourage students to integrate these resources into their practice;
- create opportunities for the educators to practice and receive feedback and coaching in the field; and
- negotiate clear guidelines at the start of the FDE with regards to the management and provision of equipment and the lecture session rules. Perhaps a learning contract could be drawn up detailing the students' and the lecturers' responsibilities in this regard. The action to be taken, should the learning contract be contravened, may also be negotiated in line with University policy. Disciplinary procedures should be clearly articulated and understood by the students at the start of the FDE.

It is further recommended that the agreement between the University in City A and the NGO branch in City B be renegotiated with the view to addressing the constraints that the agreement imposed on the teaching and learning activities in the FDE.

To address the inadequate conceptual and skills development in the FDE it is recommended that the students:

- take responsibility for meeting the requirements of the FDE, failing which disciplinary action should be taken in line with University policy;
- with a minimum Grade 12 Science and Mathematics qualification register for an extended curriculum that may include small-group tutorials and individual tuition; and
- without adequately developed physical, language and writing skills participate in additional interventions to enable them to cope with the standard curriculum.

To address the inadequate conceptual and skills development in the school context it is recommended that educators:

- use the critical outcomes to develop a learning programme that includes lesson planning and assessment for the Senior Phase using the Senior Phase documents as a guide;
- seek to promote cross-curricular activities between the Technology learning programme and other learning areas such as Natural Science and Mathematical Sciences by adopting 'themes' across these learning areas;
- implement the re-curriculated Technology learning programme to model OBE practice and focus on learning as opposed to teaching;
- pay particular attention to the appropriate conceptual and skill development to meet the developmental needs of the learners. A well-designed learning programme may build the learners' confidence and conceptual understanding so that they no longer have to rely on copying their peers' work as a coping strategy;
- form Technology learning area 'clusters' with neighbouring schools and/or fellow educators to support one another in implementing Technology in the school context;
- negotiate the provision of equipment with the learners' parents or grandparents through the Governing Council; and
- negotiate appropriate classroom rules within the scope of the school rules and action to be taken should the rules be breached. The rules and the action to be taken when the rules are breached should be clearly articulated to all stakeholders in the school context.

12.8 Further research

This research focused on the implementation of educational policy in a particular Technology INSET programme and the professional practice of educators in the classroom. Further research to evaluate the effectiveness of Technology INSET programmes and the practice of educators on a regional and national level might be useful.

Further research is also recommended to illuminate the process of teaching and learning to improve conceptual understanding and skills development in under-prepared students particularly with respect to technological, problem solving and writing skills.

One of the recommendations arising from the research findings is the re-curriculation of the FDE. Action research could be conducted into the development and implementation of the re-curriculated FDE. Likewise, action research could also be conducted in the school context to develop and implement a Technology learning programme in the Senior Phase. The development of educators as reflective practitioners who are capable of evaluating their own and their peers' practice in the teaching and learning environment would also lend itself to action research.

Another useful area of research could be to ascertain which Science and Mathematics concepts and skills are essential for the development of the students' and the learners' technological skills in INSET and in the Technology learning area in the school context. Further research could also be conducted to ascertain how equipment 'tools' aid the conceptual and skills development in INSET and the Technology learning area in the school context.

12.9 Final comment

The aim of this research was to understand how emerging educational policy was implemented in the FDE and practiced in the school context. The research findings suggest that educational policy is an 'ideal' to be strived for however, the policy does not take into account the challenges facing INSET implementation due to the under-preparedness and inadequate education of the educators. Perhaps it may not be possible, given the conditions in the Eastern Cape Province to achieve this 'ideal' in a two-year, part-time programme.

Within the limitations of Activity Theory and the focus on 'contradictions' in this research, the findings suggest that the participating educators are not likely to be major change agents in the transformation of education in South Africa, as was shown by Chinien *et al* (1995:unpaged) in the transition to Technology Education in Canada. This research seems to support the views of Fullen and Hargreaves (1992:7) and Feiman-Nemser (1990:214) that educator education is a weak intervention incapable of overcoming the educators' own personal schooling or the impact of work experience.

APPENDIX A

The NQF structure (S.A. DoE 1997b:30)

<table>
<tr><th>School Grades</th><th>NQF Level</th><th>Band</th><th colspan="2">Types of qualifications & certificates</th></tr>
<tr><td></td><td>8</td><td rowspan="4">Higher Education and Training Band</td><td colspan="2">Doctorates
Further research degrees</td></tr>
<tr><td></td><td>7</td><td colspan="2" rowspan="3">Degrees,
Diplomas &
Certificates</td></tr>
<tr><td></td><td>6</td></tr>
<tr><td></td><td>5</td></tr>
<tr><td colspan="5">Further Education and Training Certificates</td></tr>
<tr><td>12</td><td>4</td><td rowspan="3">Further Education and Training Band</td><td colspan="2">School/College/NGOs
Training certificates, Mix of units</td></tr>
<tr><td>11</td><td>3</td><td colspan="2">School/College/NGOs
Training certificates, Mix of units</td></tr>
<tr><td>10</td><td>2</td><td colspan="2">School/College/NGOs
Training certificates, Mix of units</td></tr>
<tr><td colspan="5">General Education and Training Certificates</td></tr>
<tr><td rowspan="4">9
8
7
6
5
4
3
2
1

R</td><td rowspan="4">1</td><td rowspan="4">General Education and Training Band</td><td>Senior Phase</td><td>ABET 4</td></tr>
<tr><td>Intermediate Phase</td><td>ABET 3</td></tr>
<tr><td>Foundation Phase</td><td>ABET 2</td></tr>
<tr><td>Pre-school</td><td>ABET 1</td></tr>
</table>

APPENDIX B

The critical outcomes (S.A. SAQA 1997:7)

The following are Critical Outcomes that can successfully be embedded within unit standards:

1 *Identify and solve problems in which responses display that responsible decisions using critical and creative thinking have been made.*

2 *Work effectively with others as a member of a team, group, organisation, community.*

3 *Organise and manage oneself and one's activities responsibly and effectively.*

4 *Collect, analyse, organise and critically evaluate information.*

5 *Communicate effectively using visual, mathematical and/or language skills in the modes of oral and / or written presentation.*

6 *Use science and technology effectively and critically, showing responsibility towards the environment and health of others.*

7 *Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.*

In order to contribute to the full personal development of each learner and the social and economic development of the society at large, it must be the intention underlying any programme of learning to make an individual aware of the importance of:

1 *Reflecting on and exploring a variety of strategies to learn more effectively;*

2 *Participating as responsible citizens in the life of local, national and global communities;*

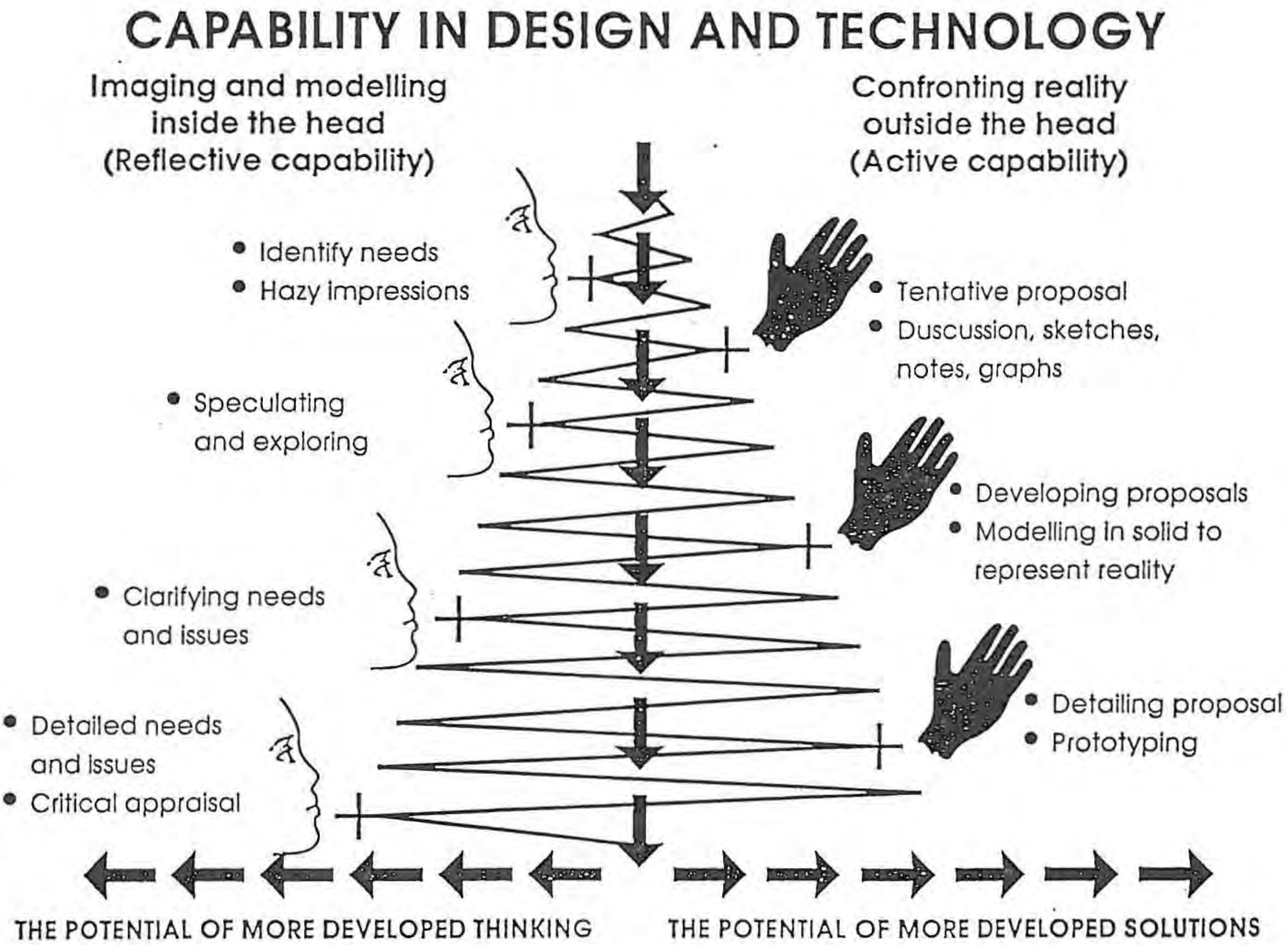
3 *Being culturally and aesthetically sensitive across a range of social contexts;*

4 *Exploring education and career opportunities, and*

5 *Developing entrepreneurial opportunities.*

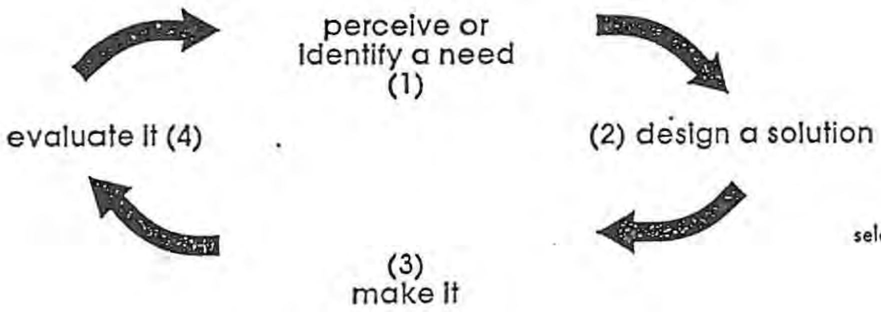
APPENDIX C

Diagrammatic representation of a 'technological capability' (Ter-Morshuizen 1994:14)

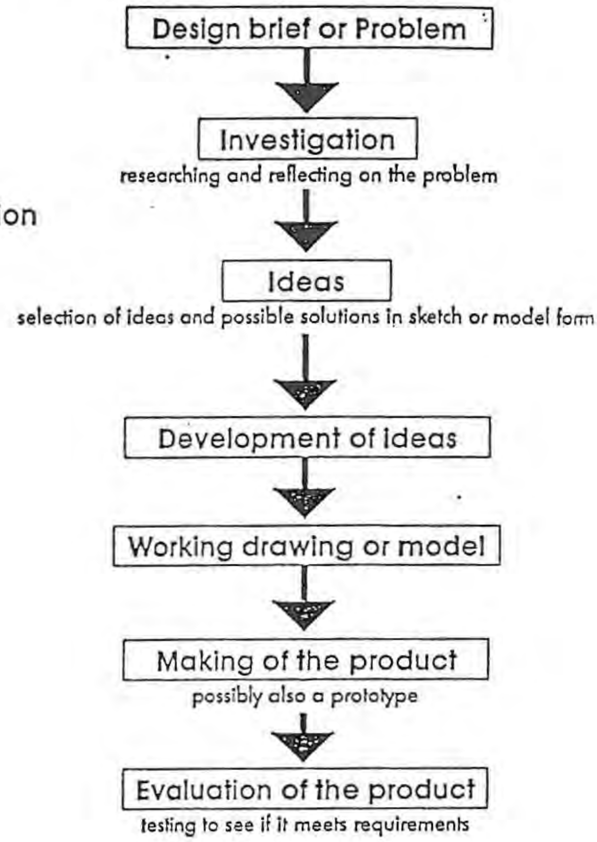


A circular and linear model of the technological process (Ter-Morshuizen 1994:12-16)

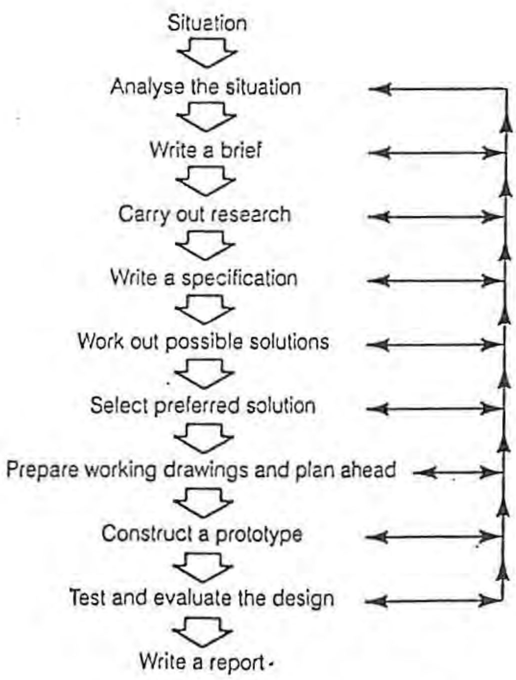
A Circular Model



A Linear Model



A Process Model of the technological process (Garratt 1991:9)



APPENDIX E

The Technology Learning Area Senior Phase document (S.A. DoE 1997g:8-25)

SO1 Understand and apply the Technological Process to solve problems and to satisfy needs and wants

The Technological Process refers to the cycle of investigating problems, needs and wants and the designing, developing and evaluating of solutions in the form of products and systems. The Technological Process is the basis of all technological endeavour. An understanding of the process is fundamental to the acquisition of technological literacy. The Technological Process is an integrated and indivisible one and therefore assessment should apply to the whole process.

ASSESSMENT CRITERIA	RANGE STATEMENT	PERFORMANCE INDICATORS
Learners should indicate an understanding and application of the Technological Process by presenting work in which: 1. Problems, needs and wants are identified and explained	At this level learners should show detailed, logical and articulate work indicating understanding of the integrated nature of the Technological Process. Learners should engage in processes of: • investigating (research, etc.) • planning and designing • developing (constructing, making, modelling, etc.) • evaluating (measuring, testing, deciding, etc.) Learners should apply the Technological Process in respect of the following South African and global themes: housing, textiles, communications, water, transport, food, energy, health, tourism, agriculture, manufacturing, media, sport and recreation; and in the following Learning Contexts: Perspective: local, national, international Modes: individual, pair and group work Presentation styles: oral, written, graphical,	*This will be evident when learners are able to:* • use a variety of methods, devices, and processes to conduct inquiries to identify needs and opportunities and to communicate their findings • reflect on the task and suggest ways forward by conducting investigations with accuracy, thoroughness, persistence, creativity, honesty and sensitivity to bias • express a description of the brief 8.
	modelling, products, artefacts and simulation Resources: texts, interviews, observation, experimentation	
2. A range of possible and relevant solutions are considered		• develop own specifications for the design e.g. generate to an increasing degree a plan, which includes resources available e.g. materials, tools and equipment • gather relevant information (refer to OC3) • take into consideration the accuracy, thoroughness, persistence, and creativity to determine a range of relevant solutions to a problem • solve problems in different ways and accept that other people's ways of solving them may be equally valid (This is also applicable to outcomes 6 & 7)
3. An informed choice is made		• recognise, taking into account a range of constraints, and select from a range of appropriate techniques to make a choice
4. A design is developed		• apply graphic techniques in a variety of media and methods of inquiry.(e.g. free hand and instrument drawing including 2D and 3D) • problem solving through modelling (e.g. mock-ups) • detail the stages to be followed in making the design (include tools and equipment to be used)
5. Solutions are realised according to design		• follow the sequence of actions and possible parallel actions to realise the design using selected tools and materials 9.

		• complete task by demonstrating an ability to manage time effectively and efficiently and carry out accurate costing analysis for projects
6. Realised solution is evaluated		• determine if the design solves the problem and meets the design specifications • carry out appropriate tests on their solutions and use test results to indicate and implement improvements
7. Process is recorded and communicated		• use a variety of methods to record, and communicate the Technological Process using multi-media presentations 10.

SO2: Apply a range of technological knowledge and skills ethically and responsibly

Technological knowledge and skills form the backbone of this learning area as it increases the learner's capability to engage confidently with the technological process and within a technological world. This outcome further seeks to develop the learner's ability to apply this acquired knowledge and skills in an ethical and responsible manner.

In this outcome evidence of achievement should show the acquisition of knowledge and skills in respect of the nature, functions and applications of:

- safety
- information
- materials
- energy

in

- Systems and Control
- Communication
- Structures
- Processing

In practice learners will engage the above in an integrated way.

ASSESSMENT CRITERIA	RANGE STATEMENTS	PERFORMANCE INDICATORS
Learners will present work in which: 1. Knowledge and understanding of • Systems and Control is reflected	SYSTEMS AND CONTROL; COMMUNICATION; STRUCTURES AND PROCESSING At this level learners will practice and develop: • investigation skills which include researching, recording, investigating, etc. • design skills which include planning, communicating, graphics, etc. • manipulation skills which include creating and modification according to specifications • evaluation skills including testing, drawing conclusions etc. • sensitivity to problems, dilemmas, issues and choices in society	*This will be evident when learners are able to:* 11-

	Systems and Control These skills will be applied within an understanding of: • input, process, output • open and closed systems • concepts of technological systems • components, devices and operations • the way signals and information flows in and between systems • the multiple and complex nature of interconnections between and within as well as the control of: ◊ mechanical ◊ electrical and ◊ hydraulic / pneumatic systems	Mechanical systems: • integrate mechanical systems with others in order to produce desired outcomes • analyse the effectiveness of simple mechanical systems • develop systems that can control more than one variable and calculate the mechanical advantage in simple mechanical systems Electrical and electronic systems: • understand electrical concepts and basic laws (e.g. ohm, lenz) and test and analyse more complex electrical circuits • use electronic components as building blocks for controlling input and output (e.g. transistor as a switch and amplifier) • understand the function and nature of process devices and basic instrumentation and be able to use these to develop and analyse more complex control tools Hydraulic and Pneumatic systems: • demonstrate an understanding of the relationship between volume, area of the piston, displacement and the effect of the force applied • demonstrate an understanding that internal forces are evenly extended in all directions and that a liquid is not compressible • calculate mechanical advantage and displacement in hydraulic systems • use simple valves (e.g.: one way, release, and safety) in order to control movement and mechanical advantage • integrate simple hydraulic systems with others in order to perform more complex tasks 12.

• Communication is reflected	Communication: These skills will be applied within an understanding of: the use of appropriate technical design and development skills, technical language and conventions for product development to meet given purposes and specifications (e.g. layout, printing, graphics and data presentation)	Communication • use their understanding of 2D and 3D, instrument drawing, visual and spatial perception to produce simple working drawings of prototypes • integrate drawings, tables, graphs, charts and notes to effectively communicate and justify design decisions
• Structures is reflected	Structures These skills will be applied within an understanding of: • Complex, made structures • Reinforcing within ◊ complex made structures ◊ composite materials • Internal and external forces • Simple calculations and formulae associated with volume, force, and other structural theory concepts Context: Shelter, transport, storage, container-isation etc.	Structures • identify and understand the function of basic structural components e.g. columns, beams, arches, buttresses, struts, stays, guys and ties • demonstrate an understanding that the stability of structures is affected by the size of the base angle, base size and distribution of load • demonstrate an understanding that materials can be reinforced and strengthened in various ways (e.g. triangulation, folding) • identify the types and direction of forces in a structure • demonstrate an understanding that loads can be static or dynamic and the effects that these have on structures • use a range of conventional and composite materials to design structures which are able to meet specific design requirements
• Processing is reflected	Processing These skills will be applied within an understanding of: The activity of processing raw materials into refined materials and into products, with waste as a by-product. Processes:	Processing • demonstrate an understanding that raw materials are processed in a variety of ways to enhance their value or produce new commodities • demonstrate an understanding that these processes normally involve: - combining (e.g. developing a natural flavoured yoghurt): - 13.

	• conversion • preservation • reduction • combination Context: biotechnology, manufacturing, agriculture, mining	extraction (e.g. bleaching, m dehydration, distillation, washin preservation (e.g. sterilisation, de salting, cooking, pasteurisation, refrig pickling and canning); - conversion (e.g. into plank); - Joining (e.g. gluing); - processing commodities (e.g. extracting juice from oranges) • show evidence that attention is given to issues like hygiene, safety, cost, efficiency and marketability when processing materials.
2. knowledge and understanding of:	ENERGY; MATERIALS; INFORMATION AND SAFETY Learners will develop a sensitivity towards, an understanding of and appropriate application skills in the use of energy, materials, information and safety as common features of all technology	
• safety	Safety • Adherence to safety regulations e.g. NOSA (National Occupational Safety Association) • Housekeeping, organisation and management • Occupational safety • Appropriate behaviour, dress and procedures • Safe use of tools, equipment and materials First aid	Safety • operate a range of portable power and hand tools safely and effectively • demonstrate an understanding that some materials have corrosive, combustible and toxic properties which require precautions during use and storage • render first aid for minor accidents when they occur • show awareness of health and safety hazards in their communities
• Information	Information • Information technology Refer to specific outcome 3.	Information • see performance indicators for Specific Outcome #3

14.

• materials and	Materials • Sources • Types - natural, synthetic and composite • Techniques ◊ Processing (separating, combining, converting, joining, shaping and forming) ◊ Storage ◊ Preservation ◊ Distribution • Properties (physical, chemical and aesthetic) • Selection (form, function, potential and suitability) • Cost • Waste management of materials	Materials • select materials to meet design specifications using criteria like their properties, cost and availability • consider the impact of the selection of material and the waste of their design on the environment.
• energy as they manifest in Systems and Control	Energy • Types and sources • Energy transformation • Energy storage and distribution • Energy as a resource - renewable, available and cost • Application	Energy • identify the types and sources of energy (e.g. nuclear from chemical) • demonstrate an understanding of how energy is transformed from one type to another (e.g. potential to kinetic) • demonstrate an understanding that energy can be stored and distributed (e.g. cell and from power station to home) • take into consideration the renewable and non renewable sources of energy and their cost • develop mechanisms demonstrating the use of energy
3 A range of hand and power tools and equipment are used.	Tools and equipment Understanding the operating principles of tools and equipment. Selection, use and maintenance of tools and equipment: • hand tools and power tools	Tools • work efficiently and safely using complex hand tools (e.g. tap and dye set) and equipment (e.g. pop-riveted) • complex power tools (e.g. baking oven, drill

15.

	• simple and complex • electric, pneumatic, electronic, mechanical • applications (cutting, soldering, cooking, etc.) Learners should apply the Technological Process in respect of the following South African and global themes: housing, textiles, communications, water, transport, food, energy, health, tourism, agriculture, manufacturing, media, sport and recreation	press)
4. Sensitivity to possible ethical issues and dilemmas is demonstrated		**Ethical issues** • show a sensitivity to ethical issues (e.g. industrial espionage and paraphrasing)
5. Responsible behaviour is demonstrated.		**Responsible behaviour** • demonstrate responsible behaviour when working with materials, tools and equipment alone and with others 16.

SO3: Access, process and use data for technological purposes

One of the features of a rapidly changing world is the accumulation of vast amounts of information and data which has an increasing impact on technology and all other aspects of modern life. In order for learners to engage effectively in the Technology Process, they need to be competent and confident in working with various forms of information and data.

ASSESSMENT CRITERIA	RANGE STATEMENT	PERFORMANCE INDICATOR
rners should produce work in which :		*This will be evident when learners are able to:*
1. Various types of data are accessed	At this level learners should produce work that is articulate, logical and detailed. They should use combinations of data types in an integrated way to investigate, analyse and make decisions. Learners should understand:	• observe, research and locate relevant data from given and other sources • use numerical, texts and graphical data
2. Various types of data are processed	**Data storage and communication forms:** • verbal / non-verbal • audio • visual • electronic **Data types:** • numerical • text • graphics within the context of the following processes: • access (identify, observe, research, locate etc.)	• arrange, compare, evaluate, analyse and communicate data
3. Various types of data are used	• process (collate, communicate, compare, evaluate etc.) • use (apply, make choices, accept, reject etc.) Learners should apply data for technological purposes in respect of the following South African and global themes: housing, textiles, communications, water,	• use data in order to make technological choices e.g. accept or reject solutions • use data in the solving of technological problems 17.

	transport, food, energy, health, tourism, agriculture, manufacturing, media, sport and recreation. and in the following Learning Contexts: <u>Perspective</u>: local, national, international <u>Mode</u>: individuals, pairs, groups <u>Presentation</u>: oral, written, graphical, modelling and simulation <u>Resources</u>: texts, interviews, observation, experimentation	18.

SO4 Select and evaluate products and systems

All learners are exposed to a wide variety of products and systems. They, therefore, need to acquire the critical skills necessary to operate confidently as discerning consumers and users of technology.

ASSESSMENT CRITERIA	RANGE STATEMENTS	PERFORMANCE INDICATORS
Learners will be able to present work in which: 1. Products and systems are effectively selected 2. Products and systems are effectively evaluated	Learners at this level should produce work which is: • logical and articulate • indicating evidence of the selection and evaluation of products and systems Selection and Evaluation • understand the need • derive and prioritise the constraints that may influence the choice • compare the characteristics and function of a range of similar products in respect of prioritised constraints • test and evaluate products and systems Products and Systems • a range from simple to complex designs • a range from simple to complex applications • mechanical, electrical and electronic • services (e.g. postal service) Constraints and factors In drawing comparisons learners should consider factors such as: • costs and value • aesthetics and ergonomics • social • environmental	*This will be evident when learners are able to:* • select and evaluate products and systems using the factors and constraints listed in the range statements • draw comparisons between simple products and systems • draw comparisons between complex products and systems 19.
	• materials • durability • life expectancy • fit to purpose • availability and maintenance	20.

SO5: Demonstrate an understanding of how different societies create and adapt technological solutions to particular problems

Technology is interwoven with the economic, social and cultural fabric of societies. These and other factors have influenced the way technology has evolved in different places and at different times. Learners need to understand the complex and diverse ways in which technology evolves.

ASSESSMENT CRITERIA	RANGE STATEMENTS	PERFORMANCE INDICATORS
Learners should produce work in which: 1. Various factors are considered 2. Casual relationships between given/main factors influencing technological development are reflected upon 3. Different technological solutions are compared 4. New solutions are predicted	Learners at this level should show detailed, logical and articulate work which reflects: Content • historical • geographical • cultural • economic Process • research • observation • analysis Context <u>Perspective</u>: local, national, international <u>Mode</u>: individuals, pairs, groups <u>Presentation:</u> oral, written, graphical, modelling and simulation <u>Resources</u>: texts, interviews, observation, experimentation	*This will be evident when learners are able to:* • research, observe, analyse and consider various historical factors that influence the use of transport etc. • research, observe, analyse and consider cultural factors that influence technology in respect of food, clothing, tools and utensils • research, observe, analyse and consider economic factors that influence technology • describe and analyse the inter - relationships between a range of factors that influence technological developments • investigate and discuss a range of indigenous technologies and compare these to high tech solutions 21.
		• identify and compare different technological solutions by testing and researching differences and similarities in different technological solutions, within and across various societies • motivate whether and how one solution may be more effective than the other • predict and describe possible new solutions • select and model or simulate one of these solutions 22

SO6: Learners will demonstrate an understanding of the impact of technology

Human values and other factors influence technology. Technology in turn shapes and influences the nature and well being of society, the economy and the natural environment, in both intended and unintended ways. Learners need to appreciate the ways in which technology effects all aspects of life. Outcomes 6 and 7 should preferably be achieved by integrating them with tasks and activities designed to achieve outcomes 1 to 5

ASSESSMENT CRITERIA	RANGE STATEMENT	PERFORMANCE INDICATORS
Learners should produce work in which: 1. Technological impact in a variety of contexts is reviewed	At this level learners should be able to research, analyse and draw conclusions and make predictions about the positive and/or negative impact of technology in the following: Contexts • society • the environment • the economy; Perspectives • local • national and • global Time scales • short • medium and • long term Consequences • intended and unintended nature	*This will be evident when learners are able to:* • Investigate the positive and/or negative impac of technology in the home • discuss the positive and/or negative impact of technology in the school • record the positive and / or negative impact of technology in the environment • investigate / discuss / record / how technology or the lack thereof influences/ influenced the quality of human life in different societies • demonstrate an understanding of the nature of uses and abuse of information 23.

SO7: Learners will demonstrate an understanding of how technology might reflect different biases and create responsible and ethical strategies to address them.

During the course of human history technology has been used to both promote and counter bias. Bias has also influenced the development and use of technology. Learners need to be aware of these relationships and aware of possible bias in their involvement in technological activities.

Outcomes 6 and 7 should preferably be achieved by integrating them with tasks and activities designed to achieve outcomes 1 to 5

ASSESSMENT CRITERIA	RANGE STATEMENTS	PERFORMANCE INDICATORS
Learners should produce work in which:	*At this level learners should:*	*This will be evident when learners are able to:*
1. The concept and types of biases are identified and understood	• understand the nature and causes of bias • be sensitive to and understand the complex ways in which bias affects important groups such as ◊ gender ◊ race ◊ age ◊ disability At this level learners should: • research and analyse how access to and benefits of technology have been denied to various groups • understand the impact of this bias on such groups • understand how the use and application of technology reflects, interests, priorities and biases in society	• identify, investigate and explain types of biases within the context of technology; these could include gender, race, age and/or disability 24.
2. Biases limiting access to and the application of technology are identified	At this level learners should identify existing biases and suggest possible strategies to counter these biases and address their effects	• research and analyse ways in which access to and benefits to technology have been denied to various groups • demonstrate an understanding of how this bias in technology have impacted on particular groups • research and analyse how the use and application of technology reflects priorities, power relations and biases • research and analyse the contributions made to technology by women and men internationally
3. Strategies to address biases are developed		• developed strategies to address biases as they relate to technology 25.

APPENDIX F

The educator roles and applied competences (COTEP 1998:68-80)

Roles and exit level outcomes

The contextual roles and competences for the Schooling sub-field provide the exit level outcomes. These six roles and their associated competences provide the substance of teacher education qualifications and learning programmes. They are in effect the *norms* for teacher education; they describe what is to be considered the *normal* expectation of a teacher. They are, therefore, the central feature of all initial pre-service qualifications. The critical cross-field outcomes and the proposed ETDP standards are integrated into the roles and their applied competences.

The ROLES that a teacher must be prepared to play are:

Mediator of learning

The teacher will mediate learning in a manner which is sensitive to the diverse needs of learners; construct learning environments that are appropriately contextualised and inspirational; communicate effectively showing recognition of and respect for the differences of others. In addition, a teacher will demonstrate sound knowledge of subject content and various principles, strategies and resources appropriate to teaching in a South African context.

68.

Interpreter and designer of learning programmes and materials

The teacher will understand and interpret provided learning programmes, design original learning programmes, identify the requirements for a specific context of learning and select and prepare suitable textual and visual resources for learning. The teacher will also select, sequence and pace the learning in a manner sensitive to the differing needs of learners.

Leader, administrator and manager

The teacher will make decisions appropriate to the level, manage learning in the classroom, carry out classroom administrative duties efficiently and participate in school decision-making structures. These competences will be performed in ways which are democratic, which support learners and colleagues, and which demonstrate responsiveness to changing circumstances and needs.

Scholar, researcher and lifelong learner

The teacher will achieve ongoing personal, academic, occupational and professional growth through pursuing reflective study and research in the learning area, in broader professional and educational matters, and in other related fields.

Community, citizenship and pastoral role

The teacher will practise and promote a critical, committed and ethical attitude towards developing a sense of respect and responsibility towards others, one that upholds the constitution, and promotes democratic values and practices in schools and society.
Within the school, the teacher will demonstrate an ability to develop a supportive and empowering environment for the learner and respond to the educational and other needs of learners and fellow educators. In addition the teacher will develop supportive relations with parents and other key persons and organisations based on a critical understanding of community development issues.

Learning area/subject/discipline/phase specialist

The teacher will be well grounded in the knowledge, skills, values, principles, methods, and procedures relevant to the discipline, subject, learning area and/or phase of study. The teacher will know about different approaches to teaching and learning and how these may be used in ways which are appropriate to the learner and the context. The teacher will have a well developed understanding of the content knowledge appropriate to the specialism. 69.

Learning mediator

Practical competences	NQF Level			
(The demonstrated ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)	HCE	DE	B.Ed	PGCE
Using the language of instruction appropriately to explain, describe and discuss key concepts in the particular learning area/subject/discipline/phase.	5	5	6	6
Using a second official language to explain, describe and discuss key concepts in a conversational style.	4	4	5	5
Employing appropriate strategies for working with learner needs and disabilities, including sign language where appropriate.	5	5	6	6
Preparing thoroughly and thoughtfully for teaching by drawing on a variety of resources; the knowledge, skills and processes of relevant learning areas; learners' existing knowledge, skills and experience.	5	6	6	6
Using key teaching strategies such as higher level questioning, problem-based tasks and projects; and appropriate use of group-work, whole class teaching and individual self-study.	5	6	6	6
Adjusting teaching strategies to: match the developmental stages of learners; meet the knowledge requirements of the particular learning area; cater for cultural, gender, ethnic, language and other differences among learners.	5	6	6	6
Adjusting teaching strategies to cater for different learning styles and preferences and to mainstream learners with barriers to learning.	5	6	6	6
Creating a learning environment in which: learners develop strong internal discipline; conflict is handled through debate and argument, and learners seek growth and achievement.	5	5	5	5
Creating a learning environment in which: critical and creative thinking is encouraged; learners challenge stereotypes about language, race, gender, ethnicity, geographic location and culture.	4	5	6	6
Using media and everyday resources appropriately in teaching including judicious use of: common teaching resources like text-books, chalkboards, and charts; other useful media like OHPs, computers, video and audio (etc); and popular media and resources, like newspapers and magazines as well as other artefacts from everyday life.	5	5	5	5
Making appropriate use of different assessment practices, with a particular emphasis on: competence-based assessment and the formative use of assessment, in particular continuous and diagnostic forms of assessment.	5	6	6	6

Foundational competences	HCE	DE	B.Ed	PGCE
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)				
Understanding different explanations of how language mediates learning: the principles of language in learning; language across the curriculum; language and power; and a strong emphasis on language in multi-lingual classrooms.	4	5	5	5
Understanding different learning styles, preferences and motivations.	5	5	5	5
Understanding different explanations of how learners learn at different ages, and potential causes of success or failure in these learning processes.	5	6	6	6
Understanding the pedagogic content knowledge – the concepts, methods and disciplinary rules – of the particular learning area being taught	5	5	6	6
Understanding the learning assumptions that underpin key teaching strategies and that inform the use of media to support teaching.	5	6	6	6
Understanding the nature of barriers to learning and the principles underlying different strategies that can be used to address them.	4	5	5	5
Understanding the assumptions that underlie a range of assessment approaches and their particular strengths and weaknesses in relation to the age of the learner and learning area being assessed.	4	5	6	6
Understanding sociological, philosophical, psychological, historical, political and economic explanations of key concepts in education with particular reference to education in a diverse and developing country like South Africa.	5	5	6	6
Exploring, understanding, explaining, analysing and utilizing knowledge, skills and values underpinning ETD practices.	4	5	6	6

Reflexive competences	HCE	DE	B.Ed	PGCE
(In which the learner demonstrates ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)				
Reflecting on the extent to which the objectives of the learning experience have been achieved and deciding on adaptations where required.	5	6	6	6
Defending the choice of learning mediation action undertaken and arguing why other learning mediation possibilities were rejected.	5	5	6	6

Reflexive competences	HCE	DE	B.Ed	PGCE
Analysing the learning that occurs in observed classroom interactions and in case studies.	5	5	6	6
Making judgements on the effect that language has on learning in various situations and how to make necessary adaptations.	4	5	6	6
Assessing the effects of existing practices of discipline and conflict management on learning.	5	5	5	5
Reflecting on how teaching in different contexts in South Africa affects teaching strategies and proposing adaptations.	4	5	5	5
Reflecting on the value of various learning experiences within an African and developing world context.	4	5	6	6
Reflecting on how race, class, gender, language, geographical and other differences impact on learning, and making appropriate adaptations to teaching strategies.	4	5	6	6
Critically evaluating the implications for schooling of political social events and processes and developing strategies for responding to these implications.	4	5	6	6

Interpreter and designer of learning programmes and materials

Practical competences	HCE	DE	B.Ed	PGCE
(The demonstrated ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)				
Interpreting and adapting learning programmes so that they are appropriate for the context in which teaching will occur.	5	5	5	5
Designing original learning programmes so that they meet the desired outcomes and are appropriate for the context in which they occur.	4	5	6	6
Adapting and/or selecting learning resources that are appropriate for the age, language competences, culture and gender of learning groups or learners.	5	5	5	5
Designing original learning resources including charts, models, worksheets and more sustained learning texts. These resources should be appropriate for subject; appropriate to the age, language competence, gender, and culture of learners; cognisant of barriers to learning.	4	5	6	6
Writing clearly and convincingly in the language of instruction.	5	5	5	6
Using a common word processing programme for developing basic materials.	4	4	4	5

Practical competences	HCE	DE	B.Ed	PGCE
Evaluating and adapting learning programmes and resources through the use of learner assessment and feedback.	4	5	6	6

Foundational competences	HCE	DE	B.Ed	PGCE
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)				
Understanding the principles of curriculum: how decisions are made; who makes the decisions, on what basis and in whose interests they are made.	5	6	6	6
Understanding various approaches to curriculum and programme design, and their relationship to particular kinds of learning required by the discipline; age, race, culture and gender of the learners.	4	5	6	6
Understanding the principles and practices of OBE, and the controversies surrounding it, including debates around competence and performance.	5	6	6	6
Understanding the learning area to be taught, including appropriate content knowledge, pedagogic content knowledge, and how to integrate this knowledge with other subjects.	5	6	6	6
Knowing about sound practice in curriculum, learning programme and learning materials design including: how learners learn from texts and resources; how language and cultural differences impact on learning.	4	5	6	6
Understanding common barriers to learning and how materials can be used to construct more flexible and individualised learning environments.	5	5	5	5

Reflexive competences	HCE	DE	B.Ed	PGCE
In which the learner demonstrates ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)				
Reflecting on changing circumstances and conditions and adapting existing programmes and materials accordingly.	5	6	6	6
Critically evaluating different programmes in real contexts and/or through case studies both in terms of their educational validity as well as their socio-political significance.	4	6	6	6

Leader, administrator and manager

Practical competences	HCE	DE	B.Ed	PGCE
(The demonstrated ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)				
Managing classroom teaching of various kinds (individualised, small group etc.) in different educational contexts and particularly with large and diverse groups.	5	5	5	5
Constructing a classroom atmosphere which is democratic but disciplined, and which is sensitive to culture, race and gender differences as well as to disabilities.	5	5	5	5
Resolving conflict situations within classrooms in an ethical sensitive manner.	5	5	5	5
Promoting the values and principles of the constitution particularly those related to human rights and the environment.	5	5	5	5
Maintaining efficient recording and reporting of academic progress.	5	5	5	5
Maintaining efficient financial controls.	4	4	5	5
Working with other practitioners in team-teaching and participative decision making.	4	5	5	5
Accessing and working in partnership with professional services and other resources in order to provide support for learners.	4	5	5	5
Respecting the role of parents and the community and assisting in building structures to facilitate this.	5	5	5	5

Foundational competences	HCE	DE	B.Ed	PGCE
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)				
Understanding approaches to problem-solving, conflict resolution and group dynamics within a South African and developing world context characterised by diversity.	5	6	6	6
Understanding various approaches to the organisation of integrated teaching programmes and team teaching.	5	5	5	5
Understanding various approaches to the management of classrooms, with particular emphasis on large, under-resourced and diverse classrooms.	5	6	6	6
Understanding descriptive and diagnostic reporting within a context of high illiteracy rates among parents.	5	5	6	6

Foundational competences	HCE	DE	B.Ed	PGCE
Knowledge of available professional and community support services and strategies for using their expertise.	4	5	5	5
Understanding current legislation on the management of learners and schools.	4	5	5	5
Knowledge of teachers' unions, the South African Council for Educators and other relevant professional bodies.	5	5	5	5
Understanding constitutional commitments to human rights and the environment.	4	5	5	5

Reflexive competences	HCE	DE	B.Ed	PGCE
(In which the learner demonstrates ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)				
Reflecting on strategies to assist teachers working on integrated teaching programmes and in team teaching.	5	5	6	6
Critically examining a variety of management options, making choices based on existing and potential conditions, and defending these choices.	4	5	6	6
Adapting systems, procedures and actions according to circumstances.	4	5	6	6

Community, citizenship and pastoral role

Practical competences	HCE	DE	B.Ed	PGCE
(The demonstrated ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)				
Developing life-skills, work-skills, a critical, ethical and committed political attitude, and a healthy lifestyle in learners.	5	5	5	5
Providing guidance to students about work and study possibilities.	5	5	5	5
Showing an appreciation of, and respect for, people of different values, beliefs, practices and cultures.	5	5	5	5
Being able to respond to current social and educational problems with particular emphasis on the issues of violence, drug abuse, poverty, child and women abuse, HIV/AIDS and environmental degradation. Accessing and working in partnership with professional services to deal with these issues.	5	5	5	5
Counselling and/or tutoring learners in need of assistance with social or learning problems.	5	5	5	5

Practical competences	HCE	DE	B.Ed	PGCE
Demonstrating caring, committed and ethical professional behaviour and an understanding of education as dealing with the protection of children and the development of the whole person.	5	5	5	5
Conceptualising and planning a school extra-mural programme including sport, artistic and cultural activities.	4	5	5	5
Operating as a teacher-mentor through providing a mentoring support system to student teachers and colleagues.	5	5	5	5

Foundational competences	HCE	DE	B.Ed	PGCE
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)				
Understanding various approaches to education for citizenship with particular reference to South Africa as a diverse, developing, constitutional democracy.	5	5	5	5
Understanding key community problems with particular emphasis on issues of poverty, health, environment and political democracy.	5	5	5	5
Knowing about the principles and practices of the main religions of South Africa, the customs, values and beliefs of the main cultures of SA, the Constitution and the Bill of Rights.	4	5	5	5
Understanding the possibilities for life-skill and work-skill education and training in local communities, organisations and business.	4	5	5	5
Knowing about ethical debates in religion, politics, economics, human rights and the environment.	4	5	5	5
Understanding child and adolescent development and theories of learning and behaviour with emphasis on their applicability in a diverse and developing country like South Africa.	5	6	6	6
Understanding the impact of class, race, gender and other identity-forming forces on learning.	5	6	6	6
Understanding formative development and the impact of abuse at individual, familial, and communal levels.	5	6	6	6
Understanding common barriers to learning and the kinds of school structures and processes that help to overcome these barriers.	5	5	5	5
Knowing about available support services and how they may be utilised.	5	5	5	5
Knowing about the kinds of impact school extra-mural activities can have on learning and the development of children and how these may best be developed in co-operation with local communities and business.	4	5	5	5

Reflexive competences	HCE	HDE	B.Ed	PGCE
(In which the learner demonstrates ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)				
Recognising and judging appropriate intervention strategies to cope with learning and other difficulties.	5	5	6	6
Reflecting on systems of ongoing professional development for existing and new teachers.	5	5	5	5
Adapting school extra curriculum programmes in response to needs, comments and criticism.	4	5	5	5
Reflecting on ethical issues in religion, politics, human rights and the environment.	4	5	5	5
Reflecting on ways of developing and maintaining environmentally responsible approaches to the community and local development.	4	5	5	5
Adapting learning programmes and other activities to promote an awareness of citizenship, human rights and the principles and values of the constitution.	4	5	5	5

Scholar, researcher and lifelong learner

Practical competences	HCE	HDE	B.Ed	PGCE
(The demonstrated ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)				
Being numerically, technologically and media literate.	4	4	5	5
Reading academic and professional texts critically.	4	5	6	6
Writing the language of learning clearly and accurately.	5	5	6	6
Applying research meaningfully to educational problems.	4	4	6	6
Demonstrating an interest in, appreciation and understanding of current affairs, various kinds of arts, culture and socio-political events.	4	5	5	5
Upholding the principles of academic integrity and the pursuit of excellence in the field of education.	5	5	5	5

Foundational competences	HCE	DE	B.Ed	PGCE
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)				
Understanding current thinking about technological, numerical and media literacies with particular reference to educators in a diverse and developing country like South Africa.	4	4	5	5
Understanding the reasons and uses for, and various approaches to, educational research.	4	5	6	6
Understanding how to access and use common information sources like libraries, community resource centres, and computer information systems like the internet.	4	4	5	5
Understanding and using effective study methods.	5	5	5	5

Reflexive competences	HCE	DE	B.Ed	PGCE
(In which the learner demonstrates ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)				
Reflecting on critical personal responses to, literature, arts and culture as well as social, political and economic issues.	4	5	5	5
Reflecting on knowledge and experience of environmental and human rights issues and adapting own practices.	4	4	5	5

Learning area/subject/discipline/phase specialist

Practical competence	HCE	DE	B.Ed	PGCE
(The demonstrated ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)				
Adapting general educational principles to the phase/subject/learning area.	5	5	6	6
Selecting, sequencing and pacing content in a manner appropriate to the phase/subject/learning area; the needs of the learners and the context.	5	5	5	5
Selecting methodologies appropriate to learners and contexts.	5	5	5	5
Integrating subjects into broader learning areas and learning areas into learning programmes.	4	5	5	5
Assessing in a manner appropriate to the phase/subject/learning area.	5	5	6	6
Teaching concepts in a manner which allows learners to transfer this knowledge and use it in different contexts.	5	5	6	6

Foundational competence	HCE	DE	B.Ed	PGCE
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)				
Understanding the assumptions underlying the descriptions of competence in a particular discipline/subject/learning area.	5	6	6	6
Understanding the ways of thinking and doing involved in a particular discipline/subject/learning area and how these may be taught.	5	6	6	6
Knowing and understanding the content knowledge of the discipline/subject/learning area.	5	5	6	6
Knowing of and understanding the content and skills prescribed by the national curriculum.	5	5	5	5
Understanding the difficulties and benefits of integrating this subject into a broader learning area.	4	5	5	5
Understanding a range of assessment approaches appropriate to the learning area/subject/discipline/phase/subfield.	5	5	6	6
Understanding the role that a particular discipline/subject/learning area plays in the work and life of citizens in South African society – particularly with regard to human rights and the environment.	4	5	6	6

Reflexive competence	HCE	DE	B.Ed	PGCE
(In which the learner demonstrates ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)				
Reflecting on and assessing own practice.	5	6	6	6
Analysing lesson plans, learning programmes and assessment tasks and demonstrating an understanding of appropriate selection, sequencing and pacing of content.	5	5	5	5
Identifying and critically evaluating what counts as undisputed knowledge, necessary skills, important values.	4	5	6	6
Making educational judgements on educational issues arising from real practice or from authentic case study exercises.	4	5	6	6
Researching real educational problems and demonstrating an understanding of the implications of this research.	4	5	6	6
Reflecting on the relations between subjects/disciplines and making judgements on the possibilities of integrating them.	4	5	6	6

APPENDIX G

The FDE on the NQF level 6b (COTEP 1998:36)

Levels	Credits						Existing REQV
8d	1200		Doctor				17
8c	1080		(360)				
8b	960						
8a	840		Master Thesis (120)				
7b	720		Master Coursework (120)	⇔	PGDE (120)		16
7a	600		B. Ed (Hons) (120)	⇔	ADE (120)		15
6b	480	B. Degree, B Tech	PGCE (120)		B. Educ (480)	FDE (480)	14
6a	360	Licentiates Nd tech. Diplomas First Degrees (360 or 480)				DE (360)	13
5b	240					HCE (240)	12
5a	120					CE (120)	11
4		FET Certificates	Certificates in ABET ECD WE				10
3							9
2							8
1		GET Certificates					7

APPENDIX H

The FDE requirements (COTEP 1998:88-89)

6.2.5 Further Diploma in Education (FDE) NQF level 6

Purpose:
To accredit further specialised subject/learning area /discipline/phase competence in teaching or mediation of learning as an advanced study intended to 'cap' an initial or general teaching qualification. Through this qualification learners will be prepared to embark on a course of study leading to B.Ed (Hons) at NQF 7. It, therefore, must include appropriate demands in terms of rigour.
Learning assumed to be in place:
Diploma in Education at NQF level 6 or RPL equivalent.
***Total credit value:** 120 with at least 72 at NQF level 6.*
***Relative Education Qualification Value (REQV):** 14*

Exit level outcomes:
A qualified practitioner at this level is able to:

*Fulfil the role of the **specialist educator** towards which the course of study is directed.*

- *The teacher will be highly competent in the knowledge, skills, values, principles, methods, and procedures relevant to the specialism.*
- *S/he will be prepared for a leadership role in the specialism.*
- *S/he will understand the role that ongoing evaluation and action research play in developing competence within the chosen specialisation and be able to carry out basic evaluations and action research projects.*
- *S/he will be able to read and understand basic educational research.*

The contextual roles will have been developed in an access qualification. The FDE should consolidate this development.
The contextual roles are:

Mediator of learning
Interpreter and designer of learning programmes and materials
Leader, administrator and manager
Scholar, researcher and lifelong learner
Community, citizenship and pastoral role
Learning area/subject/discipline/phase specialist

Assessment criteria
A qualified practitioner at this level will be able to demonstrate the competences required by the contextual roles as well as:

Present evidence of practical competence in the specialist role:
The demonstrated ability to consider a range of options/possibilities for action, make considered decisions about which action or possibility to follow, and to perform the chosen action in the specialist educator role such as:

1. *Being an expert teacher in a particular subject area.*
2. *Being an expert teacher in a particular phase or sub-field.*
3. *Being an administrator and manager in schools, other institutions or systems.*
4. *Being a specialist in the design of learning programmes and learning materials.*
5. *Being a specialist in the remediation of learning and/or behavioural difficulties.*
   Etc.

Grounded in foundational competence:
The demonstrated understanding of the knowledge and thinking which underpins the actions taken in the chosen educator role, such as:
1. *An ability to read and understand debates in the chosen field, and coherently communicate these ideas and their implication for education, in writing.*
2. *An ability to apply these ideas to practical education development tasks, such as designing a curriculum or a remedial intervention, and the ability to explain why the particular strategy has been chosen.*
3. *Understanding of the teaching, learning and curriculum appropriate to the field.*
4. *Understanding of the research practice appropriate to the subject or phase area.*
5. *An ability to carry out the research required for the extension of understanding of the field.*

Integrated through reflexive competence:
In which the learner demonstrates the ability to perform actions thoughtfully and to adapt these actions and explain the reasons behind these adaptations including:
1. *Reflecting on the contribution of this particular educator role to the overall provision of education in South Africa.*
2. *Determining the kinds of judgements and decisions appropriate to the concepts, principles and procedures relevant to the subject or phase area.*
3. *Making judgements on the different theories and debates within the chosen field and the implications of these various approaches for practice.*

Assessment:
While assessment will include the assessment of discrete skills and knowledge within units of learning, ultimately the assessment must:
1. *Be applied to the specialist role that the educator will play.*
2. *Be demonstrated in an integrative manner.*
3. *Include the learner's ability to carry out the educator role in an authentic context.*
4. *Include a demonstration of the learner's ability to adapt practice to meet changing circumstances.*

Evidence must be of an oral and written nature and can be demonstrated through a variety of options: projects, portfolios, examinations, simulated learning/teaching contexts and in situ learning/teaching contexts. For the award of the qualification through a learning programme or RPL process, evidence of applied competence must be assessed through at least three options, one of which must require face-to-face contact with learners.

APPENDIX I

The educator roles and applied competences (S. A. Government Gazette 2000:13-22)

The seven roles are:

Learning mediator
The educator will mediate learning in a manner which is sensitive to the diverse needs of learners, including those with barriers to learning; construct learning environments that are appropriately contextualised and inspirational; Communicate effectively showing recognition of and respect for the differences of others. In addition an educator will demonstrate sound knowledge of subject content and various principles, strategies and resources appropriate to teaching in a South African context.

Interpreter and designer of learning programmed and materials
The educator will understand and interpret provided learning programmed, design original learning programmed, identify the requirements for a specific context of learning and select and prepare suitable textual and visual resources for learning. The educator will also select, sequence and pace the learning in a manner sensitive to the differing needs of the subject/learning area and learners.

Leader, administrator and manager
The educator will make decisions appropriate to the level, manage learning in the classroom, carry out classroom administrative duties efficiently and participate in school decision making structures. These competence will be performed in ways which are democratic, which support learners and colleagues, and which demonstrate responsiveness to changing circumstances and needs.

Scholar, researcher and lifelong learner
The educator will achieve ongoing personal, academic, occupational and professional growth through pursuing reflective study and research in their learning area, in broader professional and educational matters, and in other related fields.

Community, citizenship and pastoral role

The educator will practise and promote a critical, committed and ethical attitude towards developing a sense of respect and responsibility towards others. The educator will uphold the constitution and promote democratic values and practices in schools and society. Within the school, the educator will demonstrate an ability to develop a supportive and empowering environment for the learner and respond to the educational and other needs of learners and fellow educators.

Furthermore, the educator will develop supportive relations with parents and other key persons and organisations based on a critical understanding of community and environmental development issues. One critical dimension of this role is HIV/AIDS education.

Assessor

The educator will understand that assessment is an essential feature of the teaching and learning process and know how to integrate it into this process. The educator will have an understanding of the purposes, methods and effects of assessment and be able to provide helpful feedback to learners, The educator will design and manage both formative and summative assessment in ways that are appropriate to the level and purpose of the learning and meet the requirements of accrediting bodies. The educator will keep detailed and diagnostic records of assessment. The educator will understand how to interpret and use assessment results to feed into processes for the improvement of learning programmed.

Learning area/subject/discipline/phase specialist

The educator will be well grounded in the knowledge, skills, values, principles, methods, and procedures relevant to the discipline, subject, learning area, phase of study, or professional or occupational practice. The educator will know about different approaches to teaching and learning (and, where appropriate, research and management), and how these may be used in ways which are appropriate to the learners and the context. The educator will have a well-developed understanding of the knowledge appropriate to the specialism.

The roles are broken down into:

- *Practical Competence*
- *Foundational Competence, and*
- *Reflexive Competence.*

Practical competence
(Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)
Using the language of instruction appropriately to explain, describe and discuss key concepts in the particular learning area/subject/discipline/phase.
Using a second official language to explain, describe and discuss key concepts in a conversational style.
Employing appropriate strategies for working with learner needs and disabilities, including sign language where appropriate.
Preparing thoroughly and thoughtfully for teaching by drawing on a variety of resources; the knowledge, skills and processes of relevant learning areas; learners' existing knowledge, skills and experience.
Using key teaching strategies such as higher level questioning. problem-based tasks and projects; and appropriate use of group-work, whole class teaching and individual self-study.
Adjusting teaching strategies to: match the developmental stages of learners; meet the knowledge requirements of the particular learning area; cater for cultural, gender, ethnic, language and other differences among learners.
Adjusting teaching strategies to cater for different learning styles and preferences and to mainstream learners with barriers to learning.
Creating a learning environment in which: learners develop strong internal discipline; conflict is handled through debate and argument, and learners seek growth and achievement.
Creating a learning environment in which: critical and creative thinking is encouraged; learners challenge stereotypes about language, race, gender, ethnicity, geographic location and culture.
Using media and everyday resources appropriately in teaching including judicious use of: common teaching resources like text-books, chalkboards, and charts; other useful media like overhead projectors, computers, video and audio (etc); and popular media and resources, like newspapers and magazines as well as other artefacts from everyday life.
Foundational competence
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)
Understanding different explanations of how language mediates learning: the principles of language in learning; language across the curriculum; language and power; and a strong emphasis on language in multi-lingual classrooms.
Understanding different learning styles, preferences and motivations.
Understanding different explanations of how learners learn at different ages, and potential causes of success or failure in these learning processes.
Understanding the pedagogic content knowledge - the concepts, methods and disciplinary rules - of the particular learning area being taught

Understanding the learning assumptions that underpin key teaching strategies and that inform the use of media to support teaching.
Understanding the nature of barriers to learning and the principles underlying different strategies that can be used to address them.
Understanding sociological, philosophical, psychological, historical, political and economic explanations of key concepts in education with particular reference to education in a diverse and developing country like South Africa.
Exploring, understanding, explaining, analysing and utilizing knowledge, skills and values underpinning ETD practices.
Reflexive competences
(Where the learner demonstrates the ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)
Reflecting on the extent to which the objectives of the learning experience have been achieved and deciding on adaptations where required.
Defending the choice of learning mediation undertaken and arguing why other learning mediation possibilities were rejected.
Analysing the learning that occurs in observed classroom interactions and in case studies.
Making judgments on the effect that language has on learning in various situations and how to make necessary adaptations.
Assessing the effects of existing practices of discipline and conflict management on learning.
Reflecting on how teaching in different contexts in South Africa affects teaching strategies and proposing adaptations.
Reflecting on the value of various learning experiences within an African and developing world context.
Reflecting on how race, class, gender, language, geographical and other differences impact on learning, and making appropriate adaptations to teaching strategies.
Critically evaluating the implications for schooling of political social events and processes and developing strategies for responding to these implications.
Critically reflecting on the ways barriers to learning can be overcome.
Critically reflecting on the degree to which issues around HIV/AIDS have been integrated into learning.
Analysing the strengths and weakness of the ways in which environmental, human rights and other critical cross-field issues have been addressed.

INTERPRETER AND DESIGNER OF LEARNING PROGRAMMED AND MATERIALS

Practical competence
(Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)
Interpreting and adapting learning programmed so that they are appropriate for the context in which teaching will occur.
Designing original learning programmed so that they meet the desired outcomes and are appropriate for the context in which they occur.

Adapting and/or selecting learning resources that are appropriate for the age, language competence, culture and gender of learning groups or learners.
Designing original learning resources including charts, models, worksheets and more sustained learning texts. These resources should be appropriate for subject; appropriate to the age, language competence, gender, and culture of learners; cognisant of barriers to learning.
Writing clearly and convincingly in the language of instruction.
Using a common word processing programme for developing basic materials,
Evaluating and adapting learning programmed and resources through the use of learner assessment and feedback.
(Where the learner demonstrates an undemanding of the knowledge and thinking which underpins the actions taken.)
Understanding the principles of curriculum: how decisions are made; who makes the decisions, on what basis and in whose interests they are made.
Understanding various approaches to curriculum and programme design, and their relationship to particular kinds of learning required by the discipline; age, race, culture and gender of the learners.
Understanding the principles and practices of OBE, and the controversies surrounding it, including debates around competence and performance.
Understanding the learning area to be taught, including appropriate content knowledge, pedagogic content knowledge, and how to integrate this knowledge with other subjects.
Knowing about sound practice in curriculum, learning programme and learning materials design including: how learners learn from texts and resources; how language and cultural differences impact on learning.
Understanding common barriers to learning and how materials can be used to construct more flexible and individualised learning environments.
Reflexive competence
(Where the learner demonstrates the ability to integrate or connect performances and decision making with undemanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)
Reflecting on changing circumstances and conditions and adapting existing programmes and materials accordingly.
Critically evaluating different programmed in real contexts and/or through case studies both in terms of their educational validity as well as their socio-political significance.

LEADER, ADMINISTRATOR AND MANAGER

Practical competence
(Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)
Managing classroom teaching of various kinds (individualised, small group etc.) in different educational contexts and particularly with large and diverse groups.
Constructing a classroom atmosphere which is democratic but disciplined, and which is sensitive to culture, race and gender differences as well as to disabilities.

Resolving conflict situations within classrooms in an ethical sensitive manner.
Promoting the values and principles of the constitution particularly those related to human rights and the environment.
Maintaining efficient financial controls.
Working with other practitioners in team-teaching and participative decision making.
Accessing and working in partnership with professional services and other resources in order to provide support for learners.
Respecting the role of parents and the community and assisting in building structures to facilitate this.
Foundational competence
(Where the learner demonstrates an undemanding of the knowledge and thinking which underpins the actions taken.)
Understanding approaches to problem-solving, conflict resolution and group dynamics within a South African and developing world context characterised by diversity.
Understanding various approaches to the organisation of integrated teaching programmed and team teaching.
Understanding various approaches to the management of classrooms, with particular emphasis on large, under-resourced and diverse classrooms.
Knowledge of available professional and community support services and strategies for using their expertise.
Understanding current legislation on the management of learners and schools.
Knowledge of educators' unions, the South African Council for Educators and other relevant professional bodies.
Understanding constitutional commitments to human rights and the environment.
Reflexive competence
(Where the learner demonstrates the ability to integrate or connect performances and decision making with undemanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)
Reflecting on strategies to assist educators working on integrated teaching programmed and in team teaching.
Critically examining a variety of management options, making choices based on existing and potential conditions, and defending these choices.
Adapting systems, procedures and actions according to circumstances.

COMMUNITY, CITIZENSHIP AND PASTORAL ROLE

Practical competence
(Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action,)
Developing life-skills, work-skills, a critical, ethical and committed political attitude, and a healthy lifestyle in learners.
Providing guidance to learners about work and study possibilities.
Showing an appreciation of, and respect for, people of different values, beliefs, practices and cultures.
Being able to respond to current social and educational problems with particular emphasis on the issues of violence, drug abuse, poverty, child and women abuse,

HIV/AIDS and environmental degradation. Accessing and working in partnership with professional services to deal with these issues.
Counseling and/or tutoring learners in need of assistance with social or learning problems.
Demonstrating caring, committed and ethical professional behaviour and an understanding of education as dealing with the protection of children and the development of the whole person.
Conceptualizing and planning a school extra-mural programme including sport, artistic and cultural activities.
Operating as a mentor through providing a mentoring support system to student educators and colleagues.
Foundational competences
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)
Understanding various approaches to education for citizenship with particular reference to South Africa as a diverse, developing, constitutional democracy.
Understanding key community problems with particular emphasis on issues of poverty, health, environment and political democracy.
Knowing about the principles and practices of the main religions of South Africa, the customs, values and beliefs of the main cultures of SA, the Constitution and the Bill of Rights.
Understanding the possibilities for life-skill and work-skill education and training in local communities, organisations and business.
Knowing about ethical debates in religion, politics, economics, human rights and the environment.
Understanding child and adolescent development and theories of learning and behaviour with emphasis on their applicability in a diverse and developing country like South Africa.
Understanding the impact of class, race, gender and other identity-forming forces on learning.
Understanding formative development and the impact of abuse at individual, familial, and communal levels.
Understanding common barriers to learning and the kinds of school structures and processes that help to overcome these barriers.
Knowing about available support services and how they may be utilised.
Knowing about the kinds of impact school extra-mural activities can have on learning and the development of children and how these may best be developed in co-operation with local communities and business.
Reflexive competence
(Where the learner demonstrates the ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)
Recognizing and judging appropriate intervention strategies to cope with learning and other difficulties.
Reflecting on systems of ongoing professional development for existing and new educators.
Adapting school extra curriculum programmed in response to needs, comments and

criticism.
Reflecting on ethical issues in religion, politics, human rights and the environment.
Reflecting on ways of developing and maintaining environmentally responsible approaches to the community and local development.
Adapting learning programmed and other activities to promote an awareness of citizenship, human rights and the principles and values of the constitution.
Critically analysing the degree to which the school curriculum promotes HIV/AIDS awareness.
Critically analysing the degree to which the school curriculum addresses barriers to learning, environmental and human rights issues.

SCHOLAR, RESEARCHER AND LIFELONG LEARNER

Practical competences
(Where the learner demonstrates the ability, in an authentic context to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)
Being numerically, technologically and media literate.
Reading academic and professional texts critically.
Writing the language of learning clearly and accurately.
Applying research meaningfully to educational problems.
Demonstrating an interest in, appreciation and understanding of current affairs, various kinds of arts, culture and socio-political events.
Upholding the principles of academic integrity and the pursuit of excellence in the field of education.
Foundational competence
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)
Understanding current thinking about technological, numerical and media literacies with particular reference to educators in a diverse and developing country like South Africa.
Understanding the reasons and uses for, and various approaches to, educational research.
Understanding how to access and use common information sources like libraries, community resource centres, and computer information systems like the internet.
Understanding and using effective study methods.
Reflexive competence....
(Where the learner demonstrates the ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)
Reflecting on critical personal responses to, literature, arts and culture as well as social, political and economic issues.
Reflecting on knowledge and experience of environmental and human rights issues and adapting own practices.

Assessor

Practical competence
(Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action,)
Making appropriate use of different assessment practices, with a particular emphasis on competence-based assessment and the formative use of assessment, in particular continuous and diagnostic forms of assessment.
Assessing in a manner appropriate to the phase/subject/learning area.
Providing feedback to learners in sensitive and educationally helpful ways.
Judging learners' competence and performance in ways that are fair, valid and reliable.
Maintaining efficient recording and reporting of academic progress.
Foundational competences
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)
Understanding the assumptions that underlie a range of assessment approaches and their particular strengths and weaknesses in relation to the age of the learner and learning area being assessed
Understanding the different learning principles underpinning the structuring of different assessment tasks.
Understanding a range of assessment approaches and methods appropriate to the learning area/subject/discipline/phase.
Understanding language terminology and content to be used in the assessment task and the degree to which this is gender and culturally sensitive.
Understanding descriptive and diagnostic reporting within a context of high illiteracy rates among parents.
Reflexive competence
(Where the learner demonstrates the ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)
Justifying assessment design decisions and choices about assessment tasks and approaches.
Reflecting on 'appropriateness of assessment decisions made in particular learning situations and adjusting the assessment tasks and approaches where necessary.
Interpreting and using assessment results to feed into processes for the improvement of learning programmed.

Learning area/subject/discipline/phase specialist

Practical competence
(Where the learner demonstrates the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibility to follow, and to perform the chosen action.)
Adapting general educational principles to the phase/subject/learning area.
Selecting, sequencing and pacing content in a manner appropriate to the phase/subject/learning area; the needs of the learners and the context.

Selecting methodologies appropriate to learners and contexts.
Integrating subjects into broader learning areas and learning areas into learning programmed.
Teaching concepts in a manner which allows learners to transfer this knowledge and use it in different contexts,
Foundational competence
(Where the learner demonstrates an understanding of the knowledge and thinking which underpins the actions taken.)
Understanding the assumptions underlying the descriptions of competence in a particular discipline/subject/learning area.
Understanding the ways of thinking and doing involved in a particular discipline/subject/learning area and how these may be taught.
Knowing and understanding the content knowledge of the discipline/subject/learning area.
Knowing of and understanding the content and skills prescribed by the national curriculum.
Understanding the difficulties and benefits of integrating this subject into a broader learning area.
Understanding the role that a particular discipline/subject/learning area plays in the work and life of citizens in South African society – particularly with regard to human rights and the environment.
Reflexive competence
(Where the learner demonstrates the ability to integrate or connect performances and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reasons behind these actions.)
Reflecting on and assessing own practice.
Analysing lesson plans, learning programmed and assessment tasks and demonstrating an understanding of appropriate selection, sequencing and pacing of content.
Identifying and critically evaluating what counts as undisputed knowledge, necessary skills, important values.
Making educational judgments on educational issues arising from real practice or from authentic case study exercises.
Researching real educational problems and demonstrating an understanding of the implications of this research.
Reflecting on the relations between subjects/disciplines and making judgments on the possibilities of integrating them.

APPENDIX J

The University FDE syllabus (1998)

	TECHNOLOGY	SCIENCE	MATHEMATICS	EDUCATION
1	• General introduction to technology • Problem solving • The Technological Process • The history of Technology • Design 1: Sketching Perspective drawing Rendering Designing • Design 2: Precision drawing • Innovation • Ethnotechnology • First Aid and Safety	• Introduction to scientific knowledge The science-technology interchange • Science and technology What is progress? What is healthy technology? Indigenous technologies • Relationship between Science and Technology	• Numbers and their applications Properties of equality Fundamentals structural properties Number patterns and generalisations Integers Sequences, series and Gaussian series Factors, multiples and primes Binary numbers, octal and hexadecimal numbers • Mathematics and technology Ethnomathematics Assessment and evaluation	• Methodology of teaching technology, science and mathematics at the primary school level • Historical overview of education • Assessment and evaluation The concept and nature of assessment The concept and nature of evaluation The application of assessment and Evaluation in the context of technology, science and mathematics at the primary school level
2	• Establishing a facility • Assessment in Technology Education • Materials and their uses 1 Introduction Properties and Types Processing Production Storage - Packaging Distribution Marketing Textiles Moulds • Curriculum Development Innovation Material Development Curriculum Design Appropriate Technology • Materials and their uses 2 Manipulation of materials Production	• Basic chemistry Molecules, molecular structure and materials Children's understanding of chemistry	• Equations and their applications Literal equations Equations and inequalities Formulae Solving equations Linear equations Quadratic equations	• Curriculum The nature and theory of curriculum Design and development of curriculum Critical evaluation of the curriculum A curriculum for African needs

	TECHNOLOGY	SCIENCE	MATHEMATICS	EDUCATION
3	• Structures Elements Buildings Bridges Construction Design Aesthetics	• Basic chemistry Molecules, molecular structure and materials Children's understanding of chemistry	• The rational numbers A system of rational numbers Ratio and proportion Solving fraction problems • Shapes and geometrics Points, lines, planes an space Properties Symmetries Polygons, tessellations and polyhedra Curves	• Critical thinking (This is also to be very closely integrated as an "approach" to teaching the other three subjects) • Teaching and learning in the second language
4	• Forces General Magnetism and its application Gravity and its application • Mechanisms and their application General Introduction Inclined plane Levers Belts and Pulleys Chains and Gears Wheels and Axles Cams and Cranks Hydraulics and Pneumatics Mechanisms and Systems Use of Kits	• Force Static objects, moving objects and force distribution Friction Levers Wheels, axles and gears Belts and pulleys Driving forces Children's understanding force	• Measurement Linear measurement Area Measurement Volume measurement Congruence and rigid motions	• Learning theory • The nature of learning • Appropriateness of various learning theories • Approaches to teaching

5	TECHNOLOGY	SCIENCE	MATHEMATICS	EDUCATION
	• Energy Sources or energy Electricity and its applications Energy in the home • Management in Technology Education Resources management Facility management	• Introduction to electronics, electricity, gravity and magnetism Charges Models of electricity flow Currents Children's understanding • Electrical models - principles and construction	• Graph theory Interpretations Application Linear Quadratic • Cartesian plane Co-ordinates Geometry Graphs	• Graphiacy
6	• Technology, pollution and the environment Impact of Technology Water Waste Pollution Energy Health • Technology, people and society History Consumerism Transportation Urbanism The community	• Problems in science Science and the environment Scientific criteria for pollution Science and social issues Science and ethics Children's understanding of Environmental and social issues	• Constructions, transformations, congruence and similarity Basic constructions Constructing parallel lines and angles Properties of angles Congruent angles Similar triangles and figures	• Environmental education Concept and development Environmental ethics

	TECHNOLOGY	SCIENCE	MATHEMATICS	EDUCATION
7	• Food Technology Production Storage Preservation Processing Distributing Marketing Hygiene Nutrition Health	• Science and food The chemistry of good preparation Human food needs Process of food production and use Children's understanding of food	• Statistics and their application Data collecting Data handling and analysis Data interpretation Measures of central tendency Measures of dispersion Normally distributed data Sampling Probability theory	• Educational resource management Teaching in an under-resourced context Parent-community interaction
8	• Information Technology Structure and function of a computer Communication Operating systems: DOS and Windows Using computers: Word processing Spreadsheets Database CD - ROM Computers in Education Using computers in research Impact of computers on Society and the Environment CAD - Computer assisted design	• Science and information technology How computers work Uses of computers Children and computers	• Logo geometry • Programming in Basic	• Society issues in education The notion of disadvantage Education and Society in South Africa

APPENDIX K

The letter of request to the NGO branch in City B

25 June 1999

Dear

re: DOCTORAL RESEARCH

Further to our meeting, on 9 June 1999, regarding my doctoral research into the professional development of participating teachers in the Technology Education INSET programme at the . I would like to thank you for your enthusiastic response and willingness to assist me in this regard. I have presented my proposal to the Education Faculty at University and my supervisor Dr is satisfied with the scope of my inquiry.

I therefore formally request your permission to conduct my research at the Institute. I am very excited about the prospect of conducting my research at the and look forward to working with you and your colleagues and students.

Yours sincerely

Christine Thomen

APPENDIX L

The letter of request to the school Principals

30 June 2000

Dear

I am a doctoral student registered in the Faculty of Education at University. I am researching what impact emerging Educational Policy (Teacher education, C2005 and OBE) has on the FDE (Technology) at University and the and the practice of participating teachers. I am presently undertaking participant observation with the students who are registered for the FDE (Technology) at University and the

The next phase of my research requires that I visit participating teachers in their schools for two or three days. Mr .... has indicated that he would like to be involved in this phase of my research. He has invited me to visit your school so that I can observe his classes. If you agree to my visit I would also like to talk with you, your staff and learners about your school and your community in order to understand the context and environment within which you teach.

I hereby request your permission and that of the School Governing Council to visit your school.

I would be very happy to furnish you with more information should you require me to do so. I may be contacted at work (043 -) or home (043 –).

Thank you very much in anticipation.

Yours sincerely

Mrs Christine Thomen

APPENDIX M

The interview guide

CURRICULUM CONTEXT:

1. **History:**
- Where did originate? When? Why? By whom?
- When was established in SA? Why? By whom?
- How many are there in SA? Where?
- How was in East London established? When? Why? By whom?

2. **Environment:**
- Is associated with the College? How? Why?
- What is the nature of the relationship with the College?
- How did form links with University? When? Why?
- What is the nature of the relationship with ?
- Is the FDE accredited by ?

3. **Philosophy:**
- What is the philosophy?
- What assumptions underpin the philosophy?
- Does the philosophy impact on the type of FDE curriculum offered? How?
- How did the assumptions influence the design (structure) of the FDE curriculum?
- Is the ' philosophy reflected in the contents of the FDE curriculum? How?
- How do the assumptions influence the content offered in the FDE modules?
- Is this philosophy similar/different from the philosophy?
- Is this philosophy similar/different from the College philosophy?
- What assumptions have been made about Technology/Science/Mathematics/Education in this FDE? Why?
- What assumptions have been made about the participants who are doing the FDE? Why?
- What assumptions have been made about the "professional development" of participants doing the FDE? Why?

4. **Emerging Policy:**
- Has the registered the FDE with SAQA/NQF? When? How?
- On which level/field has the FDE been registered?
- What is the purpose/outcome statement for the FDE?
- Does subscribe to an outcomes-based approach? How? Why?
- Does subscribe to the policy formulated by the Dept of Education for Technology Education in Curriculum 2005? How? Why?
- What is your understanding of the changes envisaged by COTEP (1998) policy?
- Will the COTEP policy change the FDE in any way? How? Why?
- What is your understanding of emerging policy (COTEP, C2005, INSET) and how will this affect the FDE?

5. INSET:

- Why INSET for this FDE?
- What are the advantages/disadvantages of INSET for this FDE?
- Why does this FDE focus on Technology Education?
- How long has the FDE been offered?
- What are the advantages/disadvantages of offering this FDE? Why?
- Who is the target market for this FDE?
- What are the implications for the FDE of having this particular target market?
- Why do you think teachers want to do a technology education FDE?
- Why do you think teachers want to do the FDE at ORT-STEP which is accredited by Rhodes?
- What are the fees? Can the students afford to do the FDE?
- What are the strengths/weaknesses of the FDE? Why?
- What are the problems/highlights experienced with this FDE? Why?
- What resources (financial, equipment and infrastructure) are available for offering the FDE?
- How do the resources (or lack thereof) influence the kind of course that is offered?
- How do the resources (or lack thereof) influence the kind of teaching methods used in the FDE?

INTENDED CURRICULUM (OVERALL FDE):

1. Aims:
- What is the aim of the FDE?
- How will you know whether or not you have achieved this aim?

2. Curriculum:
- How was the FDE curriculum designed? By whom?
- How were decisions made regarding the FDE curriculum design (structure) i.e. how many modules/how many contact hours etc? By whom?
- Was emerging policy (Curriculum 2005, COTEP, NQF) taken into consideration when planning the FDE curriculum?
- How were decisions made regarding the FDE curriculum content i.e. what is taught in each module? By whom?
- Is there collaboration/integration between the different modules in the FDE curriculum? How?
- Who develops the teaching and learning materials? How has this changed over the years? Why?
- How is the approach to the FDE related to the types of teaching and learning materials used?
- Is there a difference between the curriculum that intended to implement and the curriculum that is being implemented?
- How satisfied are you with the curriculum that is being implemented?

3. Professional development:
- What is your understanding of "professional development"?
- How is professional development integrated into the FDE curriculum?
- How will the FDE enhance the professional development of participants? How do you know?
- What observable competencies/skills/knowledge/values/attitudes will you look for in participants as evidence of professional development either on completion of this FDE or while completing the FDE?

INTENDED CURRICULUM FOR EACH MODULE (TECHNOLOGY/MATH/SCIENCE/EDUCATION):

- What are the aims of the module?
- Is there a syllabus? Where from?
- How did you interpret the syllabus into a work scheme?
- Is there collaboration/integration between the different modules in the FDE? Why/Why not
- How are decisions made with regards to the content of this module? By whom?
- What assumptions will you make about the participant's pre-knowledge when deciding on the content/setting tasks/in this module? Why?
- What teaching and learning methods do you intend to use in this module? Why?
- What outcome(s) do you intend participants to achieve in this module?
- What methods of assessment do you intend using in this module? Why?

BEFORE EACH SESSION ASK THE LECTURER:

- What is the aim of this lecture?
- What content will be covered?
- What learning outcome(s) do you intend the participants to achieve?
  1. Knowledge
  2. Skills
  3. Values and attitudes
- What teaching and learning strategies do you intend implementing?
- What methods of assessment do you intend using?

CURRICULUM OUTCOMES FOR EACH MODULE: (TECHNOLOGY/MATH/SCIENCE/EDUCATION:

AFTER EACH LECTURE ASK THE LECTURER:

- Did you achieve your aim? How do you know?
- Did you cover the content you intended to cover? Why/why not?
- Did the participants achieve the learning outcomes? Why/why not?
  1. Knowledge
  2. Skills
  3. Values and attitudes
- Did you implement the teaching and learning strategies you intended to implement? Why/why not?
- Did you use the method of assessment you intended to use? Why/why not?
- What went well/not so well during the lecture?
- What will you do differently next time?

AFTER EACH LECTURE ASK THE STUDENTS:

- What do the think the aim of the lecture was?
- What did you learn in this lecture?:
  1. Knowledge
  2. Skills
  3. Values and attitudes
- What teaching and learning strategies did the lecturer use? Were they successful? Why/why not?
- What methods of assessment were used? Were they successful? Why/why not?
- What were you able to do well/not so well in this lecture? Why?
- Will you use anything that you have learned in your teaching? How?
- Have you learned anything that has changed you in any way? How have you changed and Why?

APPENDIX N

The transcription methodology

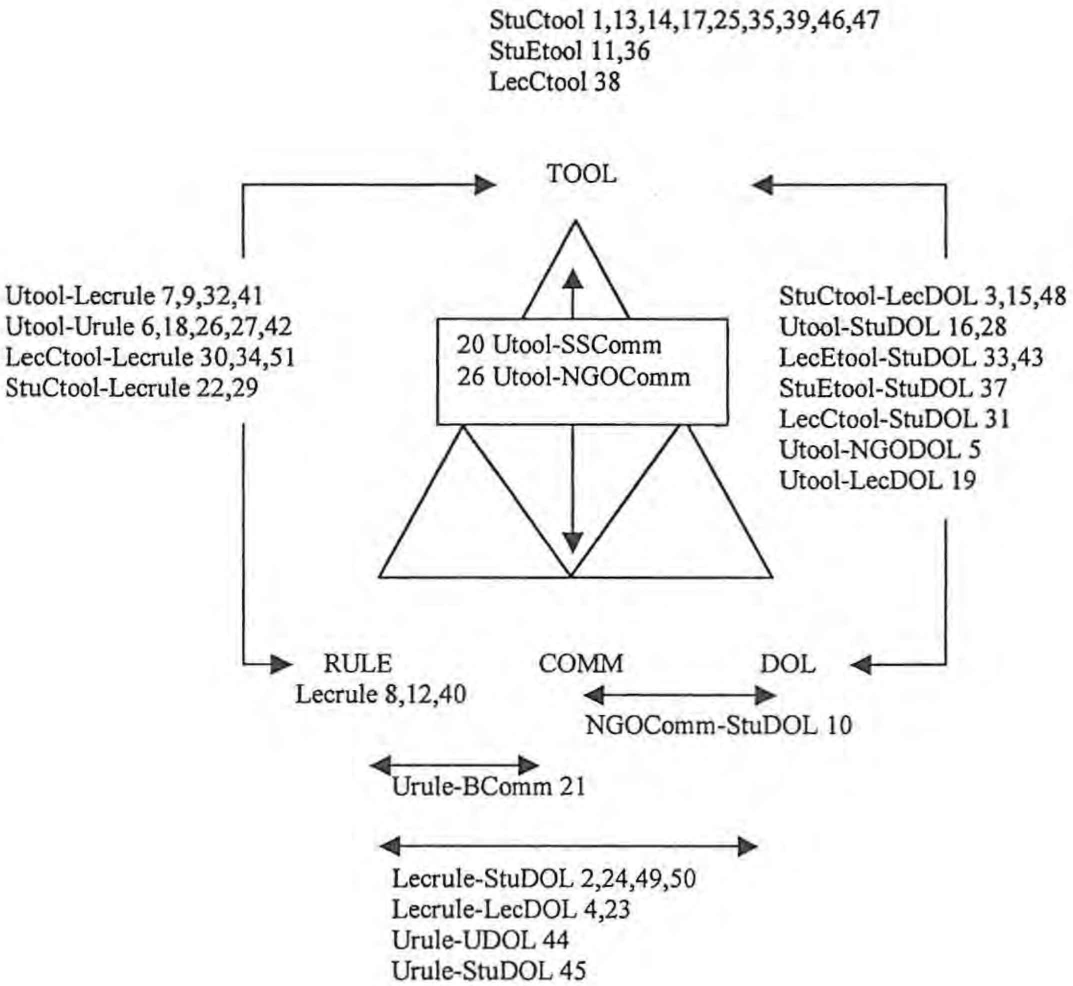
The audio-taped conversations were transcribed using the following transcription symbols:

[	Left brackets indicate the point at which a current speaker's talk is overlapped by another's talk
....	Dots indicate elapsed time in silence or pause in conversation
( )	Empty parenthesis indicate the transcriber's inability to hear what is said
(words)	Parenthesised words are possible hearings
______	Underscoring indicates some form of stress, via pitch and/or amplitude
WORD	Capitals, except at the beginning of lines, indicates especially loud sounds relative to the surrounding talk.
[*words*]	Square brackets and italics contain the author's descriptions rather than transcriptions.

(Adapted from Silverman 1993:118)

APPENDIX O

The Education Activity System contradictions



1. The students (subjects) are not sure how to plan an OBE lesson (StuCtool)

2. The students (subjects) take a long time to reach consensus on how to design an OBE lesson (StuDOL) and there is not enough time to complete the task (Lecrule)

3. The lecturer (subject) cannot effectively facilitate 120 FDE students in groups (LecDOL) to grasp the OBE lesson task (StuCtool)

4. The lecturer (subject) does not give the students the assessment criteria (LecDOL) for the OBE lesson planning assignment (Lecrule)

5. The Technology lecturer (NGODOL) does not hand out timetable to students (Utool) and the students are confused about the time and venue of the Education lecture session

6. The 300 contact hours were not met (Urule) because of late start due to delayed registration (Utool.)

7. The students (subjects) did not know which venue to go to for the Education lecture (Utool) and class starts late (Lecrule)

8. The students (subjects) arrive late for class and after tea/lunch breaks (Lecrule)

9. The students (subjects) have to hand in assignment for Education in Oct (Lecrule) but no session is scheduled for Oct (Utool)

10. The students (subjects) told to hand Education assignments (StuDOL) to Technology lecturer (NGOComm.) in Oct and this creates problems for the Technology lecturer

11. The students (subjects) do not bring their journals to the lecture session (StuEtool) and have to write on paper

12. The students (subjects) do not switch cell phones off and they ring during class (Lecrule)

13. The students (subjects) have not heard of multiple intelligences and learning styles and do not know how to apply it in practice (StuCtool)

14. The lecturer (subject) assumes that the students know about learning theories, however, not all the students do (StuCtool)

15. The lecturer (subject) discusses learning theories (LecDOL) without checking the students' understanding (StuCtool)

16. The venue provided at U (Utool) not suitable during exams and students could not complete exercise because there has to be silence (StuDOL)

17. The students (subjects) were not aware of barriers to learning and learners with special needs (StuCtool)

18. Some students (subjects) are not registered (Urule) and cannot write exams without student cards (Utool)

19. The lecturer (subject) as the FDE facilitator uses lecture time (Utool) to sort out administrative problems (LecDOL)

20. The students (subjects) want timetable 2000 (Utool) to show principal (SSComm.) so that school can plan ahead

21. The students (subjects) still have not received 'bursaries' (Urule) that they were promised from Eskom (OComm.)

22. The students (subjects) discuss in Xhosa (StuCtool) in 'expert' groups and the lecturer cannot facilitate their discussions (Lecrule)

23. The lecturer (subjects) does not give assessment criteria (LecDOL) for assignment on three learners (Lecrule)

24. The lecturer (subjects) never gave the students the opportunity to (Lecrule) present their assignments (StuDOL) to the rest of the class

25. The students (subjects) are not familiar with the COTEP document and roles of educators (StuCtool)

26. The students (subjects) request to have lecture sessions on Fridays (Utool) and they are given Monday classes because of the NGO lecturer's teaching load (Urule)

27. The test venue (Utool) is locked with not enough chairs and tables and this delays the start of the exam (Urule)

28. The students (subjects) do not know where to go to write the test (StuDOL) because of changes to venue (Utool)

29. The students (subjects) find it difficult to reach consensus (StuCtool) on how the lecturer must mark mini-test (Lecrule)

30. The students' (subjects) year mark does not include classwork, presentations and journal (LecCtool) as stated in documents (Lecrule)

31. Some students (subjects) do not participate (StuDOL) in group discussion (LecCtool)

32. The lecturer (subject) does not complete the task to draw up assessment criteria (Lecrule) because of the delays in getting the test written (Utool)

33. The lecturer (subject) does not have enough notes (LecEtool) for all students because the students take for their absent friends (StuDOL)

34. The lecturer (subject) wanted to scaffold assignment (LecCtool) but not enough time between lectures for feedback and redrafting (Lecrule)

35. The students (subjects) do not understand the cartoon (StuCtool) and the lecturer has to explain

36. The students (subjects) do not bring textbook to class (StuEtool)

37. The students (subjects) without textbooks (StuEtool) have to share with their peers (StuDOL)

38. The lecturer (subject) urges the students to get ADC help, however the lecturer is not aware that he needs to work with the ADC (LecCtool) prior to giving the assignment

39. The students (subjects) are not sure of the difference between assessment and evaluation (StuCtool)

40. The students (subjects) come late for the lecture session (Lecrule) and this creates tensions that the lecturer addresses

41. The U venue (Utool) has fixed seating and is not suitable for group discussion (Lecrule) and the lecturer moves to another venue

42. The students (subjects) are issued with temporary student cards (Utool) to get into the venue because U changed security system (Urule)

43. The students (subjects) take notes for other students (StuDOL) and then not enough notes for those present (LecEtool)

44. The students (subjects) are given a letter from FDE coordinator (UDOL) about resale (Urule) to clear up misunderstandings

45. The students (subjects) are given a warning that anyone with less than 80% attendance (StuDOL) will not write exam (Urule)

46. The students (subjects) did not understand what was required in mini management assignment (StuCtool)

47. The students (subjects) did not understand what was required in the mini research assignment (StuCtool)

48. The lecturer (subject) prepares a memo to explain procedure for mini research assignments (LecDOL) so that the students know what to do (StuCtool)

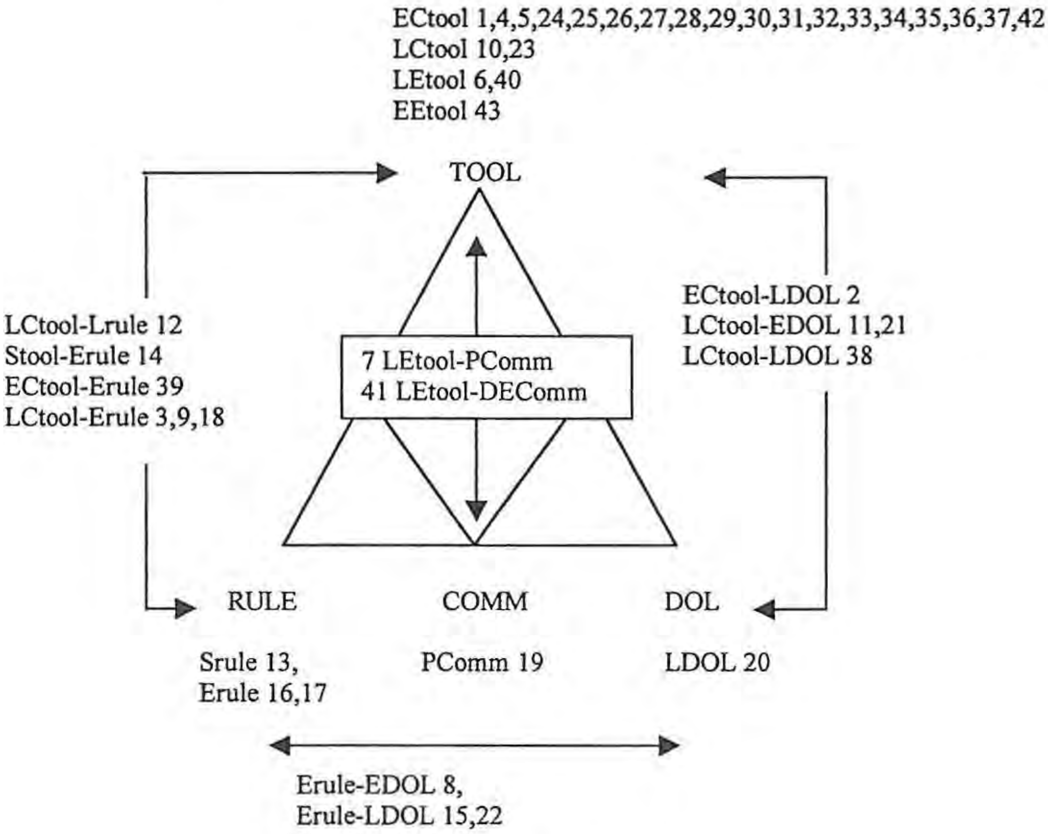
49. The students (subjects) did not know which venue to go to (StuDOL) and they arrive late for the lecture session (Lecrule)

50. The students (subjects) form five groups (StuDOL) and time is wasted getting people to move to form six groups (Lecrule)

51. The lecturer (subject) has to mark mini research assignment (LecCtool) with open assessment criteria (Lecrule)

APPENDIX P

The Lesson A Activity System contradictions



1. The educator (subject) does not a pose a problem appropriate for Grade 7 learners (ECtool)

2. The educator (subject) does not give enough information (ECtool) for the learners to engage with the task in any meaningful way (LDOL)

3. The learner (subject) replies to the question in Xhosa (LCtool) and not English (Erule)

4. The educator (subject) incorrectly refers to technological processes (ECtool) instead of '11 steps in the technological process'

5. The educator (subject) does not adequately conceptualise 'problem solving' (ECtool)

6. The learners (subjects) do not have pens, pencils, rulers and erasers (LEtool)

7. The parents (PComm) cannot/do not supply pencils, pens and rulers and erasers (LEtool)

8. The educator (subject) only checks on the front few groups and does not check on all the groups (EDOL) so cannot be sure that all groups have elected scribe, leader, judge & reporter (Erule)

9. The learners (subjects) write in English (Erule) and discuss in Xhosa (LCtool)

10. The learners (subjects) cannot remember the 11 steps in the technological process (LCtool) and therefore cannot do the task

11. The educator (subject) does not teach the skills learners need, e.g. 'design' (EDOL) to carry out the steps in the TE process (LCtools) so the learners are not able to carry out the task

12. The learners (subject) do not learn by practicing the TE skills (LCtool) because they copy (Lrule) from their previous notes

13. The educator (subject) does not follow the timetable (Srule) and continues with the lesson after break for both classes

14. The educator (subject) does not abide by the timetable (Stool) to complete the technological task (Erule)

15. The educator (subject) asks groups to elect leader and judge (Erule) but these roles are not put into action in the groups (LDOL)

16. The educator (subject) underestimates how long (Erule) it will take the learners to brainstorm their ideas so the educator changes the 'goal' to one of the steps - "possible solutions"

17. The learners (subject) talk while the educator/learner is talking (Erule) and this prevents other learners from hearing what is being said

18. The learner (subject) is confused about the concepts 'tornado' and 'lightning' (LCtool) and the educator does not correct these misconceptions (Erule)

19. The learners' and educator's (subjects) understanding of the concept 'lightning' and 'tornado' reflect community beliefs (PComm) that are incongruous with scientific facts

20. Not all the groups (subjects) report back (LDOL) because they say they have similar solutions to those already given but the educator does not know this for sure

21. The learners (subject) do not have the opportunity to think critically (LCtools) because the educator tells the learners what the solution is (EDOL)

22. The learners (subject) do not motivate their choice of solution (LDOL) as required (Erule)

23. The learners (subjects) have beliefs that have little scientific basis and this affects the judgments (LCtool) when solving the problem

24. The educator (subject) refers to 'pitch' of the roof (ECtool) without adequate explanation

25. The educator (subject) refers to 'flat roof' (ECtool) without adequate explanation

26. The educator (subject) refers to 'strong roof' (ECtool) without adequate explanation

27. The educator (subject) refers to 'research' (ECtool) without adequate understanding and explanation

28. The educator does not apply the steps in TE process in the 'correct' order (ECtool) and this does not facilitate learner's grasp of TE process

29. The educator (subject) refers the concept 'flat roof' (ECtool) without adequate explanation

30. The educator (subject) refers to the concept 'pitch' (ECtool) without adequate explanation

31. The educator (subject) refers to the concepts 'strong roof' (ECtool) without adequate explanation

32. The educator (subject) refers to the concept 'prevailing wind' (ECtool) without adequate explanation

33. The educator (subject) refers to the concept 'triangulation' (ECtool) without adequate explanation

34. The educator (subject) refers to the concept '2 D drawing' (ECtool) without adequate explanation

35. The educator (subject) refers to the concept '3 D drawing' (ECtool) without adequate explanation

36. The educator (subject) refers to the concepts 'truss' (ECtool) without adequate explanation

37. The educator (subject) refers to the concept 'working drawing' (ECtool) without adequate explanation

38. Only the one learner (subject) in the group (LDOL) designs the roof (LCtool) and not all the learners reach the goal

39. The educator (subject) does not align the assessment criteria (Erule) with the concepts he emphasised in the lesson (ECtool)

40. The learners (subjects) do not have Technology textbooks (LEtool) so the educator cannot refer to it

41. The Department of Education (DEComm) has not supplied the learners with Technology textbooks (LEtool)

42. The educator (subject) does not plan the lesson effectively for the time available (ECtool)

43. The educator (subject) does not have a textbook to use (EEtool)

APPENDIX Q

The University FDE Education course guide (1999-2000)

Further Diploma in Education (FDE)

General Education Theory Syllabus

INTRODUCTION

This course is designed for teachers who have prior teacher certification, i.e. are already qualified teachers. As such, it is assumed that the "traditional" course work in General EducationTheory was done in earlier teacher diploma studies, namely, foundation courses in the philosophy, psychology, history and sociology of education. This course will therefore avoid this "traditional" approach in its curriculum design. Instead, the teacher-learners and course facilitator have engaged in exercises and discussions in order to co-construct a course that meets 2 goals: 1) to provide teacher-learners with recent thinking and research in education theory that derive from the traditional domains mentioned above, and 2) to respond to and support teachers' needs in their classroom and school situations through an examination and understanding of relevant educational theory.

METHODOLOGY

Teaching and learning in this course will draw on a variety of methods and styles: there will be co-operative group work, individual work, presentations by lecturer and students, simulation games, videos inter alia. The lecturer's role will be to facilitate learning through a variety of methodologies, to raise teacher-learners' awareness both of theory and content as well as pedagogical processes and skills in educational studies. The students' role will be to be active participants in their own learning: to complete assignments, course readings etc. on time, and to be fully prepared to participate in class activities.

ASSESSMENT

Class work: assignments, projects, presentations, journals:	50%
Examinations	50%

Assessment criteria will be discussed with students on an ongoing basis as we engage in various projects.

COURSE OUTLINE

CLASS 1 (BLOCK 1 – Full day session)

- Introductions to each other and the subject matter of this course.
- What is learning? Group and Whole class discussion
- Strengths and Weaknesses in our system
- VIDEO: Common Miracles - A revolution in learning
- Towards co-construction of the course: Needs Assessment Exercise and discussion
- Journal Writing

Assignment 1:Part 1. Autobiography : On becoming a teacher
Part 2. The institution you work in and the students you teach
See handout for full description of assignment.

TOPICS FOR THE REST OF THE COURSE

With the exception of topic 1 below, the rest of the topics may not necessarily follow in the order listed. However, the following aspects will be addressed during this course. Please feel free to make suggestions as the course proceeds:

1. Curriculum Studies

- Curriculum theory
- OBE and C2005: where/how does it fit ?
- Developing skills to cope with C2005
- cross-curricular integration
- Examination of the ideas that have informed our past practices:

2. Learners and Learning

- How learners learn: Theories of learning
- Cognition and Critical Thinking
- Multiple Intelligences
- Learners: diversity and individual differences
- The role of language in learning

3. Teachers and Teaching

- Culture of classrooms/teaching
- teaching styles, approaches, strategies, techniques
- teacher as researcher
- teacher as reflective practitioner
- professional development
- teacher empowerment and teacher's rights

4. Assessment and evaluation

- Purpose(s) of assessment
- Various assessment models and strategies
- Assessment and C2005

5. Management Issues in Education

- Classroom issues: Discipline, Motivation and Developing "COLTS"
- Conflict resolution: various situations
- Whole school development: leadership and management issues

6. Society and Education: Links between classrooms, schools, community and society. Some pertinent issues:

- equity
- gender
- culture
- environment
- language
- "Lifeskills" issues – social and psychological problems that impact on school performance

FDE Programme

GENERAL EDUCATION
Assessment Schedule

FDE-I: 1999 & FDE II: 2000

DATE	ASSIGNMENT #	TOPIC
Given: April '99 Due: July '99	1	Autobiography, with focus on learning and teaching experiences
Given: July'99 Due: Sept'99	2a & 2b	On C2005: 2a. Exploring and reflecting on the 7 CO's in terms of own experiences. 2b. Designing and implementing OBE lesson, and Reflections
Given: Sept'99 Due : Oct '99	3	Exploring learning styles and barriers to learning: An examination of 3 different learners
Midprogramme Examinations Dec. 1999	4	The exam counts as one assignment for year mark purposes. (Q's on Assessment, Curriculum and Teaching and Learning)
Given: Apr 2000 Due: July 2000	5	Teachers Roles: Exploring the competences in relation to experience
Given: Sep 2000 Due: Oct 2000	6	Assessment Developing language support across the curriculum

FINAL EXAM IN NOV/DEC 2000

ALL of these Assignments will contribute towards the YEAR MARK, which will count for 50% of the total mark for the course.

FDE 2 EDUCATION - 2000

1. Assignment schedule

Assignment	*FDE1 [Maths/Science Class)*		*FDE1 [Technology Class]*	
Type	*Given*	*Due*	*Given*	*Due*
1. Research	Sat 1 Apr	1. Sat 6 May 2. Thu 29 Jun 3. Sat 5 aug **4. Sat 4 Nov**	Sat 1 Apr	1. Sat 3 Jun 2. Sat 5 Aug 3. Sat 2 Sep **4. Sat 7 Oct**
2. Mini	Thu 29 Jun	**Sat 5 Aug**	Sat 5 Aug	**Sat 2 Sep**
3. Mini	Sat 5 Aug	**Sat 4 Nov**	Sat 2 Sep	**Sat 7 Oct**

2. Assignments

1. <u>Full</u>
   Research in four parts

   Focus - What you consider good and what you consider bad in your learning and teaching experiences.

2/3 <u>Mini assignments</u>
   Maximum is two pages [two sides] - I will not even look at anything written beyond that

3. Evaluation

Assessment criteria will be decided in Session 1

4. Punctuality

For the full assignment if anyone wants to hand theirs in on the first date I will look at it with a view to improvement
Due dates are printed in **bold** in the schedule table
Marks will be deducted at 10% per day beyond the due date[1]

> TWO THOUGHTS
>
> - A good educator is someone who makes a difficult matter appear to be clear and easy - a poor educator is someone who makes an easy matter appear to be difficult and complicated
> - Short words say things clearly and from the heart

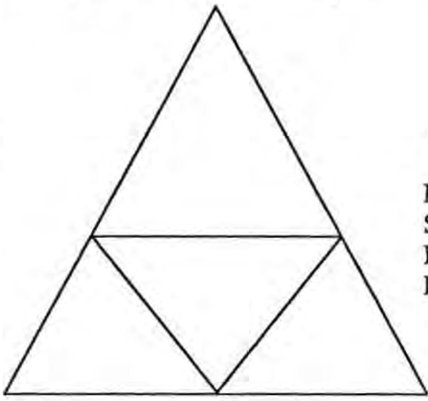
[1] The only exception that will be contemplated will be a medical condition which is supported by a professional medical document.

APPENDIX R

The Technology Activity System contradictions

StuCtool 2,10,22,23,28,29,34,40,**45,46**,57,58,59,**64,66,68**
70,83,85,95,96,97,98,99,100,101,104,105,106,107
LecCtool 38,**62,63,65,67,109,110**
StuEtool 4,26,114
LecEtool 30

TOOL



LecCtool-Lecrule **94,108**
StuCtool-Lecrule 18
StuEtool-Lecrule 115
Utool-Urule 49
StuCtool-Sturule 33

StuCtool-LecDOL 11,12,16,20,24,
52,61,82,84
LecCtool-StuDOL 51,117
StuCtool-StuDOL 39,56,73,99
LecEtool-StuDOL 31,74,116
LecCtool-LecDOL 7,41,**48**,72
StuEtool-LecDOL 27
StuEtool-StuDOL 5
Utool-StuDOL 44
Utool-LecDOL 50

RULE COMM DOL

Lecrule 1,3,8,9,15,17,21,25,32
35,55,79,88,89,103,111,112,113

StuDOL 112,92

NGOComm-StuDOL 118

Lecrule-StuDOL 6,13,14,19,36,37,42,47,54,69,71,76,80,86,87,90,91,92,102
Lecrule-LecDOL 53,75,81
Urule-UDOL 60
Urule-StuDOL 43,77
Urule-LecDOL 78,93

1. The students (subjects) arrive late for lectures (Lecrule)

2. The students (subjects) do not know how to use pencil, ruler and colouring pens to draw accurately or colour in (StuCtool)

3. The students (subjects) do not bring their cutting mats and knives (Lecrule)

4. The students (subjects) do not have cutting mats and knives to use (StuEtool)

5. The students (subjects) without cutting mats and knives (StuEtool) share with their peers (StuDOL)

6. The students (subjects) take a long time to do enlarging and rendering (StuDOL) and do not complete the task (Lecrule)

7. The lecturer (subject) changes the task from 'designing' their own box (LecCtool) and gives students a design to measure and cut card to prescribed measurements (LecDOL)

8. The students (subjects) sing while working in workshop and the lecturer tells them to be quiet (Lecrule)

9. The students (subjects) do not switch their cell phones off and they regularly go off during class (Lecrule)

10. The students (subjects) do not file notes and cannot keep track from one lecture to the next (StuCtool)

11. The lecturer (subject) tells the students how to make a cardboard box (LecDOL) and students have problems (StuCtool)

12. The lecturer (subject) demonstrates and explains how to assemble paper mache box (LecDOL) and the students have problems (StuCtool)

13. The students (subjects) do not complete the paper mache task (StuDOL) in the time available (Lecrule)

14. The students (subjects) sit in groups (Lecrule) but work individually (StuDOL)

15. The students (subjects) do not learn the notes on structures and materials (Lecrule)

16. The lecturer (subject) demonstrates how to mix paint (LecDOL) and some students mix large quantities of paint and add too much water (StuCtool)

17. Some students (subjects) do not use all the paint that they mix and waste paint (Lecrule)

18. Some students (subjects) lack painting and décor skills (StuCtool) and do not make a product of the highest level of workmanship (Lecrule)

19. Some students (subjects) do not complete painting their boxes (StuDOL) in the time available (Lecrule)

20. The lecturer (subject) does not refer to notes again (LecDOL) to check the students' understanding (StuCtool)

21. The students (subjects) talk while the lecturer is explaining how to do the icon task (Lecrule)

22. The students (subjects) are not able to identify different wood products (StuCtool)

23. The students (subjects) are confused by the difference between "blocks of wood" and "block wood" (StuCtool)

24. The lecturer (subject) demonstrates the icon task (LecDOL) and the students do not know what to do (StuCtool)

25. The students (subjects) do not bring pictures for the icon task (Lecrule)

26. The students (subjects) do not have pictures for the icon task (StuEtool)

27. The lecturer (subject) gives pictures (LecDOL) to the students without pictures (StuEtool)

28. The students (subjects) do not have skills to make a full size copy of picture (StuCtool)

29. The students (subjects) do not know how to enlarge a picture by 2:1 (StuCtool)

30. The lecturer (subject) only has one polystyrene cutter for thirty-five students to use (LecEtool)

31. The students (subjects) have to queue (StuDOL) to use the only polystyrene cutter (LecEtool)

32. Some students (subjects) crowd around the polystyrene cutting machine (Lecrule)

33. The students (subjects) speak Xhosa (StuCtool) in their groups (Sturule) and the lecturer does not understand what they are saying

34. Some students (subject) have difficulty changing 2 dim picture to 3 dim in icon task (StuCtool)

35. The students (subjects) do not study the notes on wood (Lecrule)

36. The students (subjects) do not complete the icon task (StuDOL) in the time allowed (Lecrule)

37. The students (subjects) sit in groups (Lecrule) but work individually (StuDOL)

38. The lecturer (subject) refers to 'materials' and 'equipment' interchangeably without clarifying the meaning (LecCtool)

39. The students (subjects) do not 'design' a gadget to remove the toxic waste (StuCtool) but copy and adjust an existing design of a gadget (StuDOL) from the notes

40. The students (subjects) do not know how to apply the TE process when designing the gadget (StuCtool)

41. The lecturer (subject) wants the students to 'design' a gadget (LecCtool) to remove the toxic waste (LecDtool) but students copy and adjust design of 'gadget' (StuDOL) from the notes

42. The students (subjects) do not complete the gadget design task (StuDOL) in the time allowed (Lecrule)

43. The students (subjects) do not pay (StuDOL) their tuition fees (Urule)

44. Some of the students (subjects) cannot get into U (StuDOL) because they do not have student cards (Utool)

45. Some students (subjects) use inappropriate academic writing conventions (StuCtool)

46. Some students (subjects) have problems with referencing (StuCtool) in library task

47. The students (subjects) do not complete the library task (StuDOL) in the time allowed (Lecrule)

48. The lecturer (subject) refers to outcomes in lesson planning (LecCtool) but delivers a "traditional lesson" (LecDOL)

49. The lecturer (subject) changes the starting time of lecture session (Utool) to start an exam (Urule)

50. The lecturer (subject) uses lecture time (Utool) to collect student fees (LecDOL)

51. The lecturer (subject) explains concepts like forces, levers and gravity (LecCtool) by using the 'lecture' method and the students sit and listen (StuDOL)

52. The lecturer (subject) demonstrates and explains concepts like forces, levers and gravity (LecDOL) and the students do not understand concepts (StuCtool)

53. The lecturer (subject) leaves the class (LecDOL) to talk to other students about the FDE exam and deal with photo-copiers (Lecrule)

54. The lecturer (subject) asks a question and when students do not answer (StuDOL) the lecturer gives the answer (Lecrule)

55. The students (subjects) are bored and start to talk in their groups while the lecturer is talking (Lecrule)

56. The students (subjects) do not write down (StuDOL) solutions from the board when the lecturer was explaining calculating gradient and F=ma (StuCtool)

57. The students (subjects) do not understand the difference between 'weight' and 'force' (StuCtool)

58. The students (subjects) do not understand the different forces (StuCtool)

59. The students (subjects) do not understand how to do calculations of levers and gradient (StuCtool)

60. Some students (subjects) are not registered (Urule) due to U administration problems (UDOL)

61. The lecturer (subject) discusses concepts like force, gradient, levers (LecDOL) without checking the students' understanding (StuCtool)

62. The lecturer (subject) is confused about OBE terms (LecCtool)

63. The lecturer (subject) is not sure of the type of portfolio he wants the students to compile (LecCtool)

64. The students (subjects) do not understand the difference between bibliography and reference (StuCtool)

65. The lecturer (subject) does not explain the difference between bibliography and reference (LecCtool) and tells the students to consult the U ADC

66. Most students (subjects) don't know how to plan OBE lessons (StuCtool)

67. The lecturer (subject) does not explain how to plan an OBE lesson (LecCtool) and tells the students to consult the Education lecturer

68. The students (subjects) do not understand "this portfolio thing" (StuCtool) and ask the researcher to explain

69. The students (subjects) challenge (StuDOL) the 10% deduction for late assignments (Lecrule)

70. The students (subjects) do not know what is meant by a capability task mentioned in the portfolio (StuCtool)

71. The students (subjects) who have not paid their MIP (StuDOL) will not receive a textbook (Lecrule)

72. The lecturer (subject) wants the students to 'design' (LecCtool) but he gives the students a design (LecDOL)

73. The students (subjects) do not 'design and make a balancing model' (StuCtool) but trace, cut and decorate an existing design (StuDOL)

74. The students (subjects) take notes for friends (StuDOL) who are absent and there are not enough notes for those students who are present (LecEtool)

75. The lecturer (subject) does not give assessment criteria (Lecrule) to students when he gives the portfolio assignment (LecDOL)

76. The students (subjects) work individually (StuDOL) but the desks are arranged in groups (Lecrule)

77. The students (subjects) are not fulfilling the DP requirement (Urule) which is 80% attendance (StuDOL) and this is now problematic for some students, hence the letter from FDE coordinator stating DP policy

78. The lecturer (subject) does not always take the register at start of session (LecDOL) so it is difficult to identify those students who default on attendance (Urule)

79. The students (subjects) do not do the pre-reading (Lecrule)

80. The students (subjects) do not do the pre-reading (Lecrule) and spend time during class doing the reading (StuDOL)

81. The students (subjects) ask the lecturer for the assessment criteria (Lecrule) for the hydraulic model but the lecturer does not have it (LecDOL)

82. The lecturer (subject) discusses the concepts gravity and moments (LecDOL) and the students do not understand the concepts (StuCtool)

83. The students (subjects) do not understand hydraulic systems (StuCtool)

84. The lecturer (subject) demonstrates and explains hydraulic task (LecDOL) yet the students do not know what to do (StuCtool)

85. The students (subjects) assemble hydraulic model incorrectly (StuCtool)

86. The students (subjects) do not complete the hydraulic model (StuDOL) in the time allowed (Lecrule)

87. The students (subjects) come late (Lecrule) because they have not completed their balancing toy assignments (StuDOL)

88. Most students (subjects) have not done both the model & the written assignment and want to hand one in without the other (Lecrule)

89. The students (subjects) hand their assignments in late and get penalised 10% (Lecrule)

90. The students (subjects) complete their written assignments (StuDOL) in class (Lecrule)

91. The lecturer (subject) does not start the session (Lecrule) until the students have handed in their assignment (StuDOL)

92. Some students (subjects) hand in models/assignments done by other students (StuDOL)

93. The lecturer (subject) does not enforce (LecDOL) the plagiarism policy (Urule)

94. The lecturer (subject) gives students assessment of OBE lesson in old style (Lecrule) that does not assess all aspects of the assignment, i.e. not aligned (LecCtool)

95. The students (subjects) do not understand the terminology used in the hydraulic rubric (StuCtool)

96. The students (subjects) do not know how to do calculations for gear and pulley drives (StuCtool)

97. The students (subjects) cannot explain why the ball bounces (StuCtool)

98. The students (subjects) cannot explain why the wax goes up and down (StuCtool)

99. The lecturer's (subject) notes on energy for the co-operative activity are too 'dense' for the students to understand (StuCtool) and they do not become 'experts' so cannot teach 'home' group (StuDOL)

100. The students (subjects) do not understand the notes on energy (StuCtool) and cannot make a summary for a poster

101. The students (subjects) do not know how to assemble their steam engines (StuCtool)

102. The students (subjects) do not complete the steam engine task (StuDOL) in the time allowed (Lecrule)

103. The students (subjects) do not test their steam engines (Lecrule)

104. The lecturer (subject) tells the students that the balancing toy assignments show no evidence of research (StuCtool)

105. The lecturer (subject) tells the students that the balancing toy assignments show repetition of information under different headings in the TE process (StuCtool)

106. The students (subjects) are confused about concepts of working drawings (StuCtool)

107. The students (subjects) are confused about concepts of design, portfolio (StuCtool)

108. The lecturer's (subject) assessment rubric (Lecrule) does not fit Part 2 of portfolio (LecCtool)

109. The lecturer (subject) clarifies the portfolio (LecCtool) for the students but his understanding now has changed from his original presentation

110. The lecturer (subject) misunderstands 'scaffolding' (LecCtool) to mean show or tell the students what to do for each step in the task

111. Only a few students (subjects) bring portfolios and completed steam model to class for 'work in progress' discussion (Lecrule)

112. The students (subjects) have not answered the 100 TE questions (StuDOL)

113. The students (subjects) do not bring their 'face plates' (Lecrule)

114. The students (subjects) do not have 'face plates' for the electricity task (StuEtool)

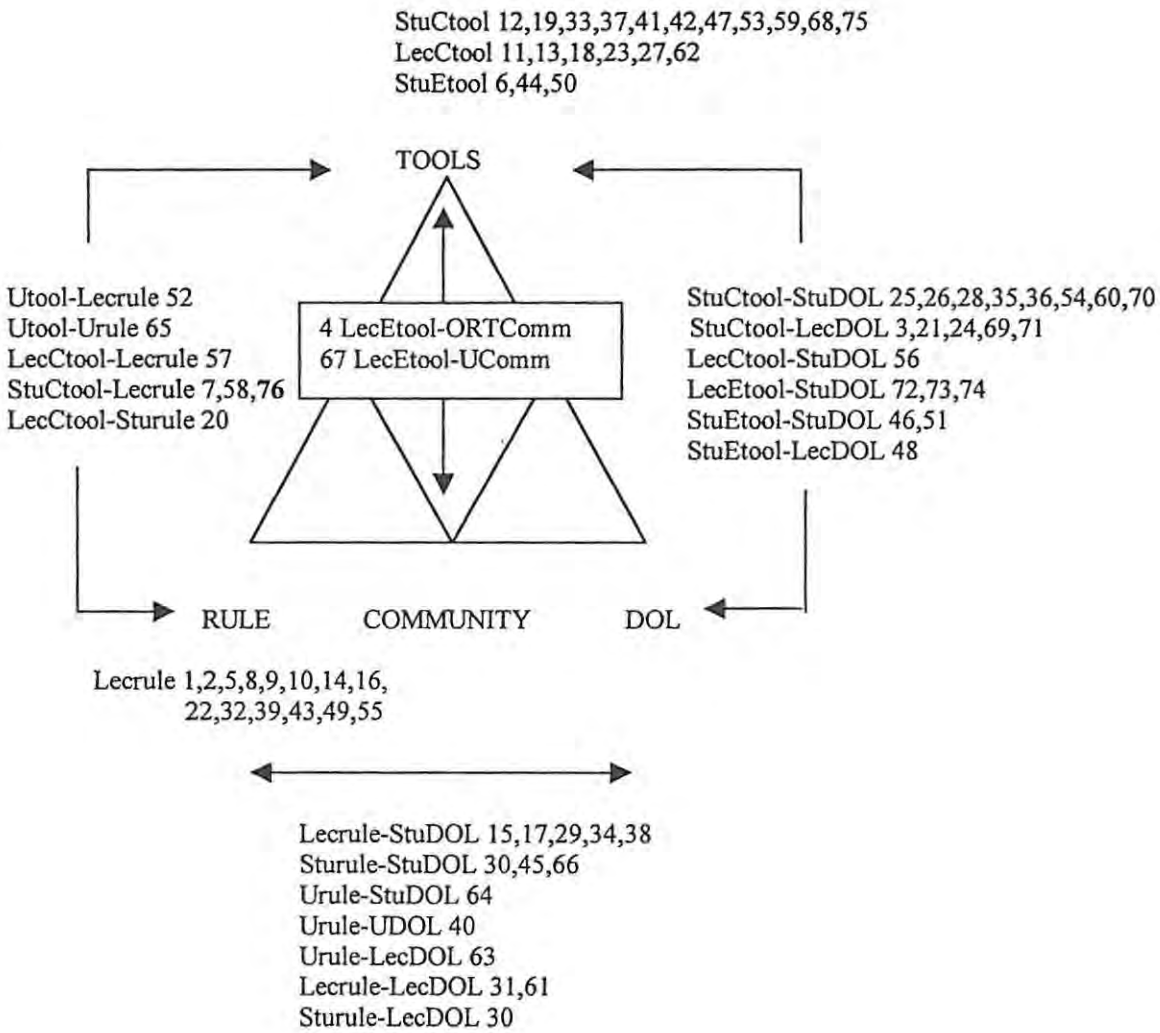
115. The students (subjects) without 'face plates' (StuEtool) make them during the lecture session (Lecrule)

116. The lecturer (subject) does not have circuit board materials (LecEtool) for students who were absent last session (StuDOL)

117. The lecturer (subject) gives the students who have not handed assignments in (StuDOL) special assignments to do (LecCtool)

118. The students (subjects) still have not paid fees (StuDOL) and the lecturer threatens them with legal action (NGOComm)

The Science Activity System contradictions



1. The students (subjects) come late for lectures and tea breaks (Lecrule)

2. The students (subjects) do not switch their cell phones off and they ring during the session (Lecrule)

3. The lecturer (subject) discusses concepts like fundamental forces, atomic structure and periodic table (LecDOL) without checking the students' understanding of the concepts (StuCtool)

4. The NGO (NGOComm) does not provide a suitably equipped venue for science teaching (NGOtool)

5. The students (subjects) do not bring science kits and microchem notes with them to class (Lecrule)

6. The students (subjects) do not have science kits and notes to use (StuEtool)

7. The students (subjects) are not familiar with using the equipment in the science kits (StuCtool) and only do Exp 5.1-5.3 (Lecrule)

8. The students (subjects) do not do the experiments at home as required (Lecrule)

9. The students (subject) do not study the notes at home (Lecrule)

10. The students (subjects) do not obtain science textbooks applicable to the phase that they teach (Lecrule)

11. The lecturer (subject) does not explain the scientific principles underlying the experiments (LecCtool) before the students do the experiments

12. The students (subjects) are not able to explain what happens in the experiments, e.g. to a gas when it is heated and cooled, how a thermometer works, the effect of cooling on different liquids (StuCtool)

13. The students (subjects) raise concerns about not having cameras/capacity to do the 'photo essay' assignment (LecCtool)

14. The students (subjects) talk while the lecturer explains experiment (Lecrule)

15. The students (subjects) decide to work in groups (StuDOL) and not pairs as required (Lecrule)

16. The students (subjects) do not record their observations in their books as required (Lecrule)

17. The students (subjects) do not complete Exp 5.8 (StuDOL) in the time available (Lecrule)

18. The lecturer (subject) does not explain the scientific principles underlying the experiment (LecCtool) before the students do experiment 5.8

19. The students (subjects) are unable to explain their observations of evaporation and temperature (StuCtool) after doing the experiment

20. The students (subjects) speak Xhosa (Sturule) and the lecturer does not know (LecCtool) if they understand the science concepts correctly

21. The lecturer (subject) gives the answers (LecDOL) when the students are unable to explain the concepts (StuCtool)

22. The students (subjects) do not conduct their own 'research' into science concepts (Lecrule)

23. The lecturer (subject) is confused about water vapour and gaseous state (LecCtool) and students challenge his interpretation

24. The lecturer (subject) tries to silence (LecDOL) one of the students who does not want to accept his interpretation of concepts (StuCtool)

25. The students (subjects) do not know how to sketch the water cycle (StuCtool) and copy the lecturer's drawing from the board (StuDOL)

26. The lecturer (subject) uses Q & A strategy to revise concepts (StuCtool) and the students get bored (StuDOL)

27. The lecturer (subject) uses a cross-curricular learning opportunity in physics without adequate explanation of the concepts (LecCtool)

28. The students (subjects) do not understand the concepts of surface area & acceleration (StuCtool) therefore cannot answer the questions or sketch the apparatus as required in the task (StuDOL)

29. The students (subjects) do not complete the cross-curricular task (StuDOL) in the time available (Lecrule)

30. The students (subjects) do not want to make mistakes (Sturule) and rely on the lecturer (as the authority) to give them the answers (LecDOL)

31. The lecturer (subject) does not allow enough time at the end of the session (Lecrule) to discuss with students the answers to the questions (LecDOL)

32. The students (subjects) arrive late for class despite later starting time (Lecrule)

33. The students (subjects) do not know how to do the moment and couple calculations (StuCtool) although this is revision from the Technology module

34. The students (subjects) cannot do the moment and couple examples (StuDOL) in the time allowed by the lecturer during the lecture (Lecrule)

35. The students (subjects) copy (StuDOL) the solutions from the ohp without knowing how to do the calculations (StuCtool)

36. The lecturer (subject) does revision by doing examples on ohp (StuCtool) and this leads to frustration and boredom (StuDOL)

37. The students (subjects) have trouble preparing a science worksheet on the computer (StuCtool)

38. The students (subjects) do math homework (StuDOL) that has to be handed in to-day (Lecrule) during the science lesson.

39. The students (subjects) do not abide by the workshop rules (Lecrule) when they try and catch up due to absenteeism

40. Some students (subjects) have not yet paid MIP (Urule) and FDE co-ordinator speaks to them (UDOL.)

41. The students (subjects) are confused because the textbook uses N/mm2 and this does not equal Pascal whereas N/m2 does (StuCtool)

42. The students (subjects) do not know how to do the calculations for VR and MA (StuCtool)

43. The students (subjects) do not bring/have calculators (Lecrule)

44. The students (subjects) do not have calculators and cannot do the task (StuEtool)

45. The students (subjects) with calculators do the calculations (StuDOL) and others copy the answers from these students (Sturule)

46. The students (subjects) do not have calculators (StuEtool) and cannot do the calculations (StuDOL)

47. The students (subjects) do not know how to use their calculators (StuCtool)

48. The students (subjects) have different makes of calculators (StuEtool) and they find it difficult to follow the lecturer's explanation for doing the calculations (LecDOL)

49. The students (subjects) do not bring their textbooks to class (Lecrule)

50. The students (subjects) do not have textbooks to use (StuEtool)

51. The students (subjects) do not have textbooks (StuEtool) and cannot do examples (StuDOL)

52. The lecturer (subject) arranges timetable (Utool) to do practical work first and theory at the end of the five-day period rather than the other way around (Lecrule)

53. The students (subjects) write on scraps of paper and do not have a 'system' for keeping track of what they do from one lecture to the next (StuCtool)

54. The lecturer (subject) explains and demonstrates (StuCtool) leading to students becoming bored (StuDOL)

55. The students (subjects) do not do the examples from the textbook at home (Lecrule)

56. The students (subjects) do not work individually but in groups (StuDOL), so cooperative activity is subverted (LecCtool)

57. The lecturer (subject) does not have clear time limits (Lecrule) for individual and group activity (LecCtool)

58. Some students (subjects) do not take the task seriously (StuCtool) and the lecturer has to remind them 'to focus' (Lecrule)

59. The students (subjects) have problems understanding the terminology VR & MA (StuCtool) in textbook

60. The students (subjects) find it difficult to do the examples (StuCtool) and ask others in the group for assistance (StuDOL)

61. The lecturer (subject) repeats the pulley demonstration (LecDOL) and students do not listen (Lecrule)

62. The students (subjects) are NOT happy about doing the "designer" task (LecCtool)

63. The lecturer (subject) takes the attendance register (LecDOL) at 17h45 just before everyone is dismissed (Urule)

64. The students (subjects) have to write a letter to FDE coordinator (Urule) to explain absence (StuDOL)

65. The students (subjects) did not know that there was no Education (Urule) class yesterday as stated in an earlier timetable draft (Utool) and students very upset

66. The students (subjects) arrange the desks (StuDOL) in groups (Sturule) before the lecturer arrives

67. The University (UComm) does not provide a suitable venue (LecEtool) for science teaching

68. The students (subjects) do not know how to diagrammatically represent the atomic model (StuCtool) dealt with in previous lectures

69. The students (subjects) do not know how to write an electron equation (StuCtool) and the lecturer realises this and tells them how to do it (LecDOL)

70. Some students (subjects) do not know how to work out the charge examples (StuCtool) and ask their friends for assistance (StuDOL)

71. Students (subjects) raise cultural beliefs about lightning (StuCtool) and the guest lecturer affirms another 'way of knowing' (LecDOL)

72. The guest lecturer (subject) does not make enough copies of notes (LecEtool) for the whole class so the students have to share (StuDOL)

73. Some of the voltmeters, bulbs, cells do not work (LecEtool) and the students (subjects) cannot do the task effectively (StuDOL)

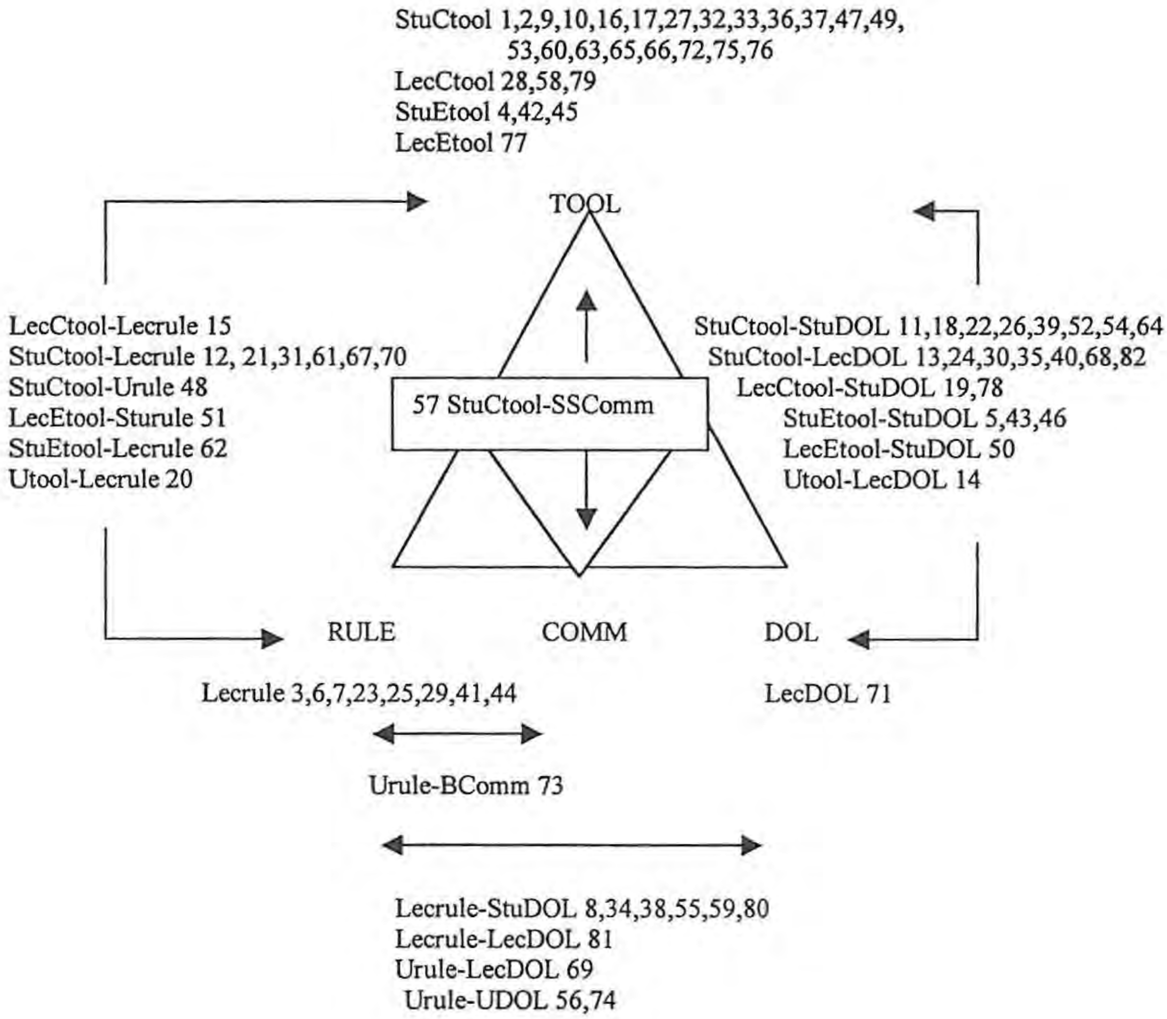
74. The students (subjects) have to share equipment (StuDOL) because there are only three sets of equipment (LecEtool) for 35 students

75. The students (subjects) do not know how to use and read the voltmeter and ammeter (StuCtool) even after the guest lecturer's explanation

76. Students (subjects) are not happy about the integrated approach (StuCtool) because they are not sure which aspects will be in each exam paper (Lecrule)

APPENDIX T

The Mathematics Activity System contradictions



1. The students (subjects) are not familiar with tangram and Pascal's triangle (StuCtool)

2. The students (subjects) have difficulty measuring accurately and cutting with knife on mat (StuCtool)

3. The students (subjects) do not bring their cutting mats and knives to class (Lecrule)

4. The students (subjects) do not have cutting mats and knives to use in class (StuEtool)

5. The students (subjects) do not have cutting mats (StuEtool) and have to share with peers (StuDOL)

6. The students (subjects) come late to class (Lecrule)

7. The students (subjects) do not switch their cell phones off during the lecture sessions (Lecrule)

8. The students (subjects) take a long time to draw Pascal's triangle (StuDOL) and do not complete the task (lecrule)

9. The students (subjects) have difficulty solving the tangram puzzles (StuCtool)

10. Some students (subjects) are not familiar with equivalency and applying BODMAS (StuCtool)

11. The students (subjects) take a long time to complete the exercises (StuDOL) on simplification (StuCtool)

12. The lecturer (subject) does not give the students enough time (Lecrule) to complete the calculations to apply BODMAS (StuCtool)

13. The lecturer (subject) discusses concepts like multiples, factors, sequences and series (LecDOL) without checking the students' understanding (StuCtool)

14. The lecturer (subject) uses lecture time (Utool) to collect student fees (LecDOL)

15. The lecturer's (subject) assessment profile focuses on the teaching aid as a product (Lecrule) and not as a process (LecCtool)

16. The students (subjects) do not know how to find the common denominator (StuCtool)

17. The students (subjects) do not know how to do fraction examples (StuCtool)

18. The students (subjects) take a long time to do the examples (StuDOL) because they do not how to apply the concepts (StuCtool)

19. The students (subjects) want the lecturer to change his method of teaching (LecCtool) so that the students can be active and not fall asleep (StuDOL)

20. The lecturer (subject) uses science class time (Utool) to complete the math lesson (Lecrule)

21. The students (subjects) want to know if 'formulae F=MA' (StuCtool) is math or science and the lecturer says it is science (Lecrule)

22. The students (subjects) do not know how to do the fraction calculations (StuCtool) and ask their peers for help (StuDOL)

23. The students (subjects) do not study the math notes (Lecrule)

24. The lecturer (subject) gives the solution (LecDOL) without the students understanding the concepts (StuCtool)

25. The students (subjects) do not lay out their work in the way the lecturer requires (Lecrule)

26. The math games (StuCtool) create competition between students, not cooperation (StuDOL)

27. The students (subjects) do not know the difference between 'rounding off' and 'recurring' (StuCtool)

28. The lecturer (subject) introduces the students to a math card game and does not fully understand the rules of the game himself (LecCtool) and withdraws the game

29. The students (subjects) do not study the notes (Lecrule)

30. The lecturer (subject) discusses ratio and proportion (LecDOL) without checking for students' understanding (StuCtool)

31. The students (subjects) want to know if calculating area (StuCtool) is math or science and the lecturer says it can be math or science (Lecrule)

32. The students (subjects) confuse and interchange lower and upper case letter in cm, mm (StuCtool)

33. Some students (subjects) do not know how to calculate area and do not write the m2 in answer (StuCtool)

34. Some students (subjects) do not have enough time (Lecrule) to do the area calculations (StuDOL)

35. The lecturer (subject) gives the solutions (LecDOL) before the students grasp the concepts (StuCtool)

36. Some students (subjects) are not sure of the meaning of 'base' and 'perpendicular height' (StuCtool)

37. Some students (subjects) confused by 'b' in 'base' with the 'b' in h=0,5b (StuCtool)

38. The students (subjects) talk while the lecturer is explaining (Lecrule) because they are still trying to do the area calculation with the help of the group (StuDOL)

39. The students (subjects) do not know how to do area calculations (StuCtool) and ask group for help (StuDOL)

40. The lecturer (subject) is doing all the talking (LecDOL) and students cannot follow his explanation of the concepts (StuCtool)

41. The students (subjects) do not bring calculators to class (Lecrule)

42 The students (subjects) do not have calculators (StuEtool)

43. The students (subjects) without calculators (StuEtool) share equipment with their peers (StuDOL)

44. The students (subjects) do not bring math equipment for use in the class (Lecrule)

45. The students (subjects) do not have math equipment to use (StuEtool)

46. The students (subjects) without math equipment (StuEtool) share instruments with their peers (StuDOL)

47. The students (subjects) do not know how to use their calculators (StuCtool)

48. The students (subjects) find it difficult to concentrate (StuCtool) from 08h00 – 17h00 (Urule)

49. The students (subjects) confuse 'shapes' with 'patterns' in the garden exercise (StuCtool)

50. The lecturer (subject) does not have enough puzzles for the number of students in the class (LecEtool) and the students have to share puzzles (StuDOL)

51. The students (subjects) are very reluctant to change their groups (Sturule) because there are only five puzzles (LecEtool)

52. Some students (subjects) have never done a puzzle before (StuCtool) and this caused anxiety and some students wanted to give up (StuDOL)

53. The students (subjects) find it difficult to do a 24 piece puzzle (StuCtool)

54. The students (subjects) do not construct their own worksheet (StuCtool) but copy the lecturer's worksheet (StuDOL)

55. The students (subjects) do not complete the patterns and puzzles worksheet (StuDOL) in the lecture session and are required to do it for homework (Lecrule)

56. The students (subjects) must pay fees to NGO branch (Urule) and not U as stated in letter sent to students (UDOL) creating confusion

57. The students (subjects) have a fear of math (StuCtool) because of their own experience at school (SSComm.)

58. The lecturer (subject) introduces 'reflection' into the lecture session for the first time (LecCtool) without explaining the relevance of the strategy to the students

59. The lecturer (subject) does not allow enough time (Lecrule) for the students to write down their thoughts or reflections (StuDOL)

60. Some students (subjects) do not find the sequence to solve the problem/puzzle (StuCtool)

61. The students (subjects) appear upset and are talking in Xhosa (StuCtool) so that the lecturer cannot understand (Lecrule), leading to tension in the room.

62. The students (subjects) without math sets (StuEtool) use coins or draw diagrams in freehand (Lecrule)

63. Some students (subjects) have difficulty doing VR, MA and η calculations (StuCtool)

64. The lecturer (subject) explains and students copy calculations (StuDOL) without really understanding symbols and concepts (StuCtool)

65. Some students (subjects) confuse N (newtons) and N (rotational frequency) (StuCtool)

66. The students (subjects) are confused by all the different formulae (StuCtool)

67. The students (subjects) want to know if VR and MA is science or math (StuCtool) because the lecturer does not make connection explicit (Lecrule)

68. The lecturer (subject) demonstrates the pulley drive system (LecDOL) and the students do not grasp the concepts when doing the calculation (StuCtool)

69. The lecturer (subject) takes the register (LecDOL) at 12h08 (Urule)

70. The students (subjects) do not remember which lesson plans (StuCtool) the lecturer is referring to that they must hand in (Lecrule)

71. Some students' (subjects) assignments/worksheets are lost (LecDOL)

72. The students (subjects) think that the lecturer has not had time to mark lesson plans so that is why they have to mark them through peer assessment (StuCtool)

73. The students (subjects) must clear debt with NGO branch (Urule) before getting R1000 'bursary' (Ocomm.)

74. Seventeen students (subjects) given final warning by FDE coordinator (UDOL) to pay fees before next session (Urule)

75. The students (subjects) have a problem with compiling OBE lesson plans (StuCtool)

76. The students (subjects) have difficulty understanding the notes on handling volumes (StuCtool)

77. The lecturer (subject) only has one set of models (LecEtool) so students cannot explore volume for themselves

78. The lecturer (subject) demonstrates volumes (LecCtool) while the students observe and are passive (StuDOL)

79. The lecturer (subject) implements a jigsaw (LecCtool) without the students being able to understand the notes

80. The students (subjects) have to leave their jigsaw activity (StuDOL) to pay their fees (Lecrule)

81. The lecturer (subject) disrupts the jigsaw activity (LecDOL) when he requires the students to pay their fees (Lecrule)

82. The lecturer (subject) covers concepts like refraction, congruent-, similar – complementary- and supplementary triangles in one three hour session (StuCtool) without checking for understanding (LecDOL)

The science revision worksheet

REVISION

Grade 5

1. What is air?
   It is a gas that contains elements such as nitrogen, oxygen and carbon dioxide.

2. Why do we need air?
   Air supports life on earth. All living creatures and plants use the oxygen in the air to maintain life.

3. Does air occupy space?
   Yes. Even when we incorrectly speak of an empty glass, it is in actual fact full of air.

4. What is combustion?
   Combustion is the process by which things burn. Fuel, heat and oxygen are needed for combustion to take place.

5. How do people use air?
   We use air to blow up balloons, inflate tyres, sailing, fans, hair dryers, etc.

Research

Conduct your own research into a) the proportions of elements in the air b) the layers in the atmosphere c) the purpose of the ozone layer d) the greenhouse effect e) The consequences of the hole in the ozone layer. → above antarctica

6. Why do animals and plants need water?
   Animals and plants have high levels of water in their composition. Water is continually evaporating out of living organisms. We need extra water to re-hydrate ourselves. Our cells need water to function properly.

7. What is evaporation and condensation?
   When water is heated or agitated by external means, surface molecules escape into the air – this is called evaporation. When the air, which is now rich in escaped water molecules, starts to cool, the molecules of water join together to form tiny droplets of water – we call this condensation.

8. What is boiling / freezing point?
   Under normal circumstances water boils at 100°C and freezes at 0°C.

Research

Conduct your own research into a) factors that affect evaporation and condensation b) dew, fog, mist, frost, snow and hail c) factors that affect freezing and boiling point temperatures.

Grade 6

1. What are the three states of H_2O?
   Ice (solid); water (liquid); steam (gas)

2. What is the water cycle?
   This is the process which enables life on earth to flourish. Heat from the sun causes water to evaporate into the atmosphere; the vapour cools to form clouds which then descend to earth as rain, snow, etc., giving moisture to the earth; small rivulets and streams merge to form rivers that transport the water back to the sea where the entire process repeats itself.

3. Does the size of the surface area, the strength of the wind and the heat of the sun effect the rate of evaporation?
   Yes!

Research

simple sketch.

a) When water freezes does its volume increase, remain constant, or decrease? b) Why does ice float to the surface in water? c) construct a pictogram of the water cycle d) investigate question 3 thoroughly, e); does salt water (sea-water) freeze?, f) does the Bering Sea freeze in winter?

Grade 7

1. What is static electricity?
   Static electricity occurs due to the ionisation of particles. Large positive and negative electrical charges build up, and are then released as a burst of electrical energy.

2. List some examples of static electricity.
   Lightning, jersey in winter, comb through hair, shock from carpets.

Research

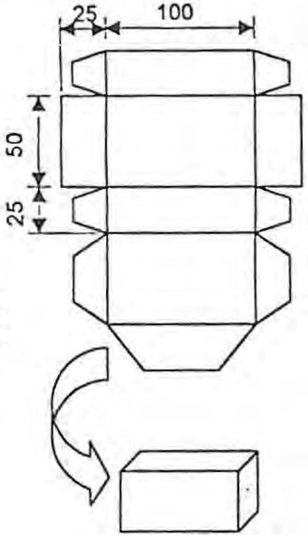
a) What is an ionised particle? b) Can you accurately write an explanation describing the phenomenon called lightning? c) Why is it dangerous to shelter under trees when thunderstorms are overhead? d) Is lightning reflected off mirrors? e) Identify two purposes of the lightning conductors placed on the top of tall buildings.

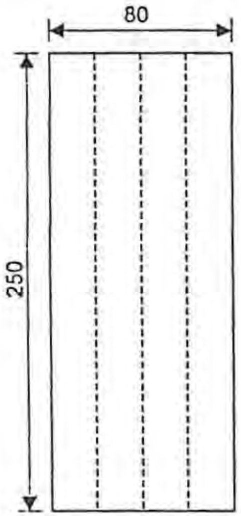
Introduction to Physics - a cross-curricular learning opportunity

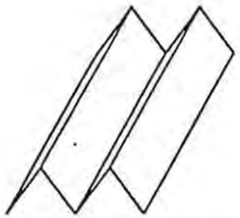
Exercise 1

Work in groups of two or three learners

Use a pencil, rule, craft knife and cutting mat (or a pair of sharp scissors) to construct the two nets below. Next, fold the nets to create a rectangular prism and a corrugated profile. Use some Pritt, Prestick or masking tape to secure the finished shapes.





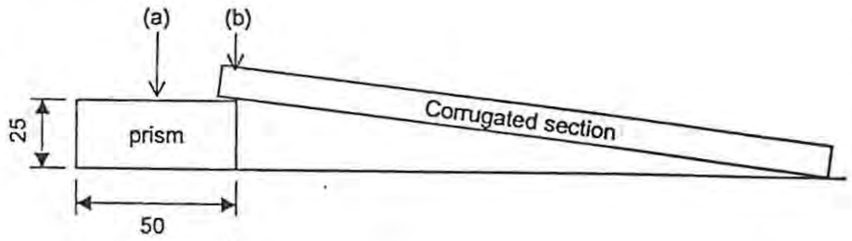


Hint: Use off-cuts to make the section more stable

Now, place your answers to the following questions in your notebook:

1. How long is the perimeter of the outer edge of the corrugated section?
2. Calculate the top surface area of the corrugated section.
3. What is the minimum size sheet of paper you could use to make the prism?
4. Calculate the total surface area of the finished rectangular prism.
5. Determine the volume of the rectangular prism.

Now, set up the apparatus as indicated below:



Carefully sketch the apparatus, then write your full answers neatly in your notebook.

6. Determine the gradient of the slope.
7. Place a marble at (a). What happens?
8. Place a marble at (b). What happens?
9. What causes the marble to roll down the slope?
10. When the marble rolls down the slope, is the velocity constant? What happens?
11. What happens when the marble reaches the bottom of the slope? Why does this happen?
12. When the marble reaches the horizontal (your table top) does it accelerate, decelerate, or move at a constant velocity? Why does this happen?
13. Move the prism about to create a new gradient. What effect does a different gradient have on the movement of the marble?
14. Drop the marble off the edge of the desk. Draw a sketch in your note book of the path of the marble from desktop to floor.
15. Allow the marble to roll off your desk at speed. Observe the trajectory (path) it follows as it falls. Repeat this process a number of times. Now draw a sketch in your book which shows the trajectory from table top to floor. Why is the trajectory of the falling marble as it is?

APPENDIX W

The balancing 'toy' assignment brief and assessment criteria

TASK: Apply the 11 steps of the technological process to the design, making, testing and evaluation of an exquisitely finished balancing toy made primarily from waste materials.

Assessment: Project 1/2000						
Name:	1-2	3-4	5-6	7-8	9-10	Score
The Portfolio and Project show evidence of:						
1. Well constructed textual information						
2. Good graphical presentation						
3. Good prototype and final product						
TOTAL						
-10% per day for late submission.						
Comments:						
Date:	Signature:					

Mark Allocation Checklist

- Well constructed textual information

(0) No evidence of consideration to this aspect is given
(1 – 4) Minimal effort in construction of information, poorly presented, very untidy
(5 – 8) A reasonable attempt, but contains elements of error/poor presentation, some untidiness
(9 - 10) Well constructed body of text, accurate and neatly presented

- Good graphical presentation

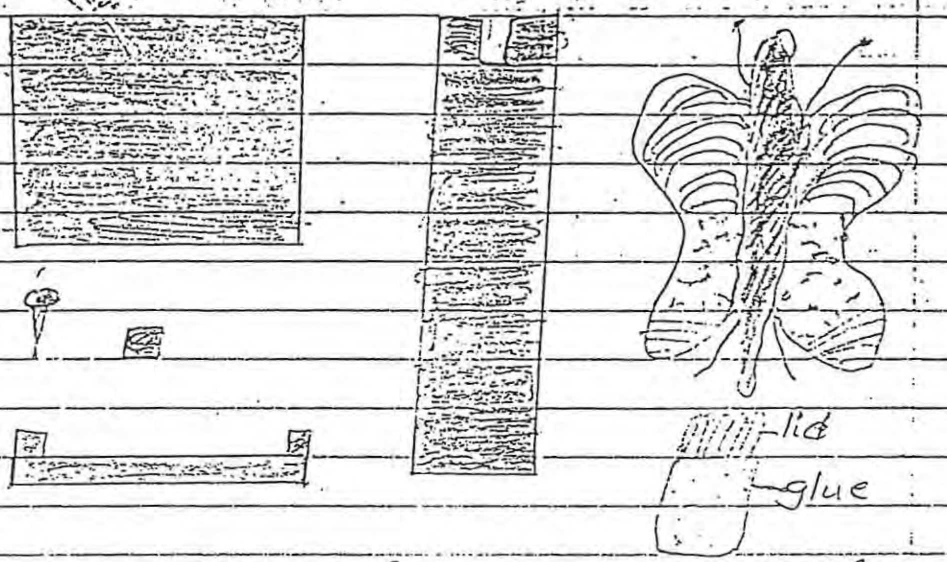
(0) A very poor attempt at an incomplete presentation
(1 – 4) Very little effort has been put into making the graphical work presentable
(5 – 8) A reasonable presentation, but could be improved upon with more effort
(9 - 10) An outstanding graphical presentation, bearing in mind the skills provided by the lecturer

- Good prototype and final product

(0) No prototype or product submitted
(1 – 4) Poorly made artefacts, using very elementary skills
(5 – 8) Well made artefacts which could be improved with more effort
(9 - 10) A beautifully constructed and finished project, well done!

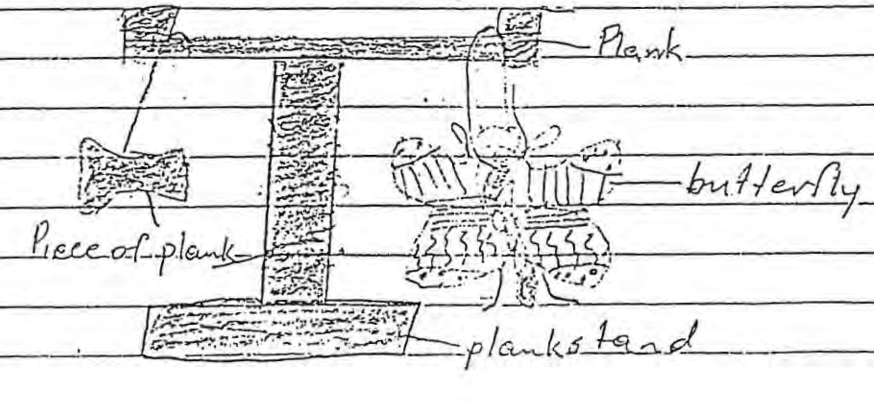
An example of a student's 'working drawings'

WORKING DRAWINGS



CONSTRUCTION PLAN: Assemble the pole of plank on a stand made from a plank stand with a glue. Cut a pole of plank on top to make a gap in the middle. Put a small plank in that gap and tie it with a wire nail and make it loose and move sideways. Hang a butterfly made from cartridge paper and pasted on the polysterene. It balances.

10. CONSTRUCT PROTOTYPE:



An example of a student's understanding of the 'technological process'

Project Number: 1/2000
Project Title: Balancing toy
Date: 6 May 2000

20%

Name: ______________________

Student Number: ______________________

Submission Date: 27 : 06 : 00

TASK: Apply the 11 steps of the technological process to the design, making, testing and evaluation of an exquisitely finished balancing toy made primarily from waste materials.

1. Situation:
Design, make, test and evalute an exquisitely finished balancing toy made ~~primerily~~ primerily from waste material. Apply the eleven steps of technological process.

repeat ref: Red Book

2. Analysis of situation:
What is required here is to apply the eleven steps of technological process, whereby I should design, make, test, and evaluate finished balancing toy. This balancing toy should be made from waste material

3. Brief:

Design, make, test and evaluate a finished balanceng toy. This balancing toy should be made from waste material. ✓

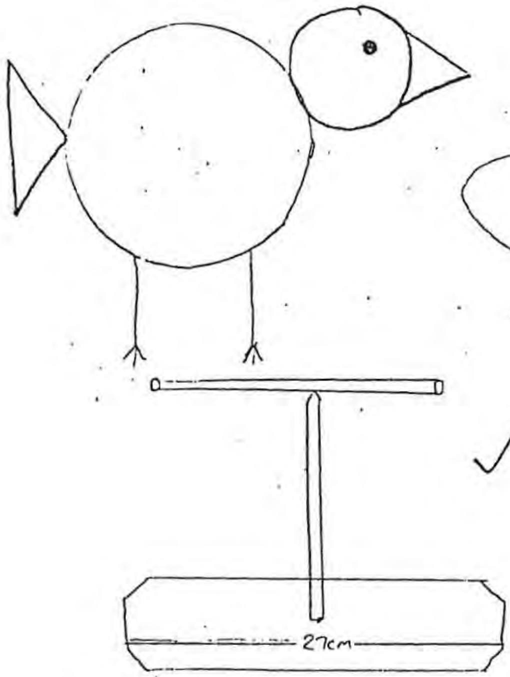
4. Research:

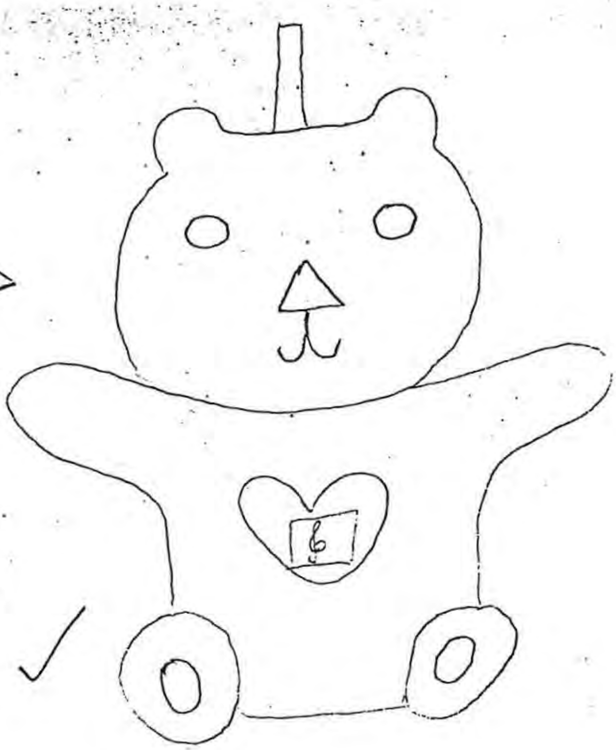
I have gone to many toy shops, such as game, CNA, little people, etc, but I did not find an interesting something I can do. I also took magazines, all different kinds, but I did not find. At last I took my baby's toy and observed it thoroughly and decided to make it. It is something like a teddy bear, that is made up of firm plastic material.

evidence

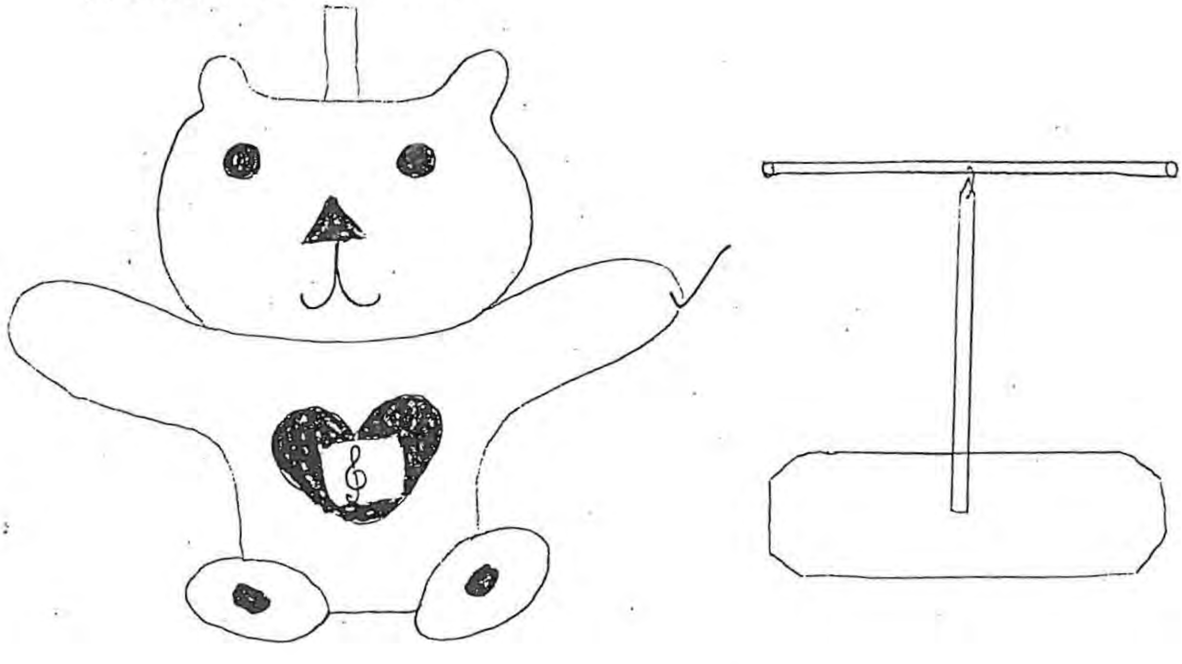
5. Specifications: The toy I am going to make is a prototype of a final product. It is made up of cardboard, wool, glue, using crayons to colour, also the balancing scale is made up of wood, I also use plastic container, with sand to balance the toy, selotape is used to join the parts inside

6. Possible Solutions

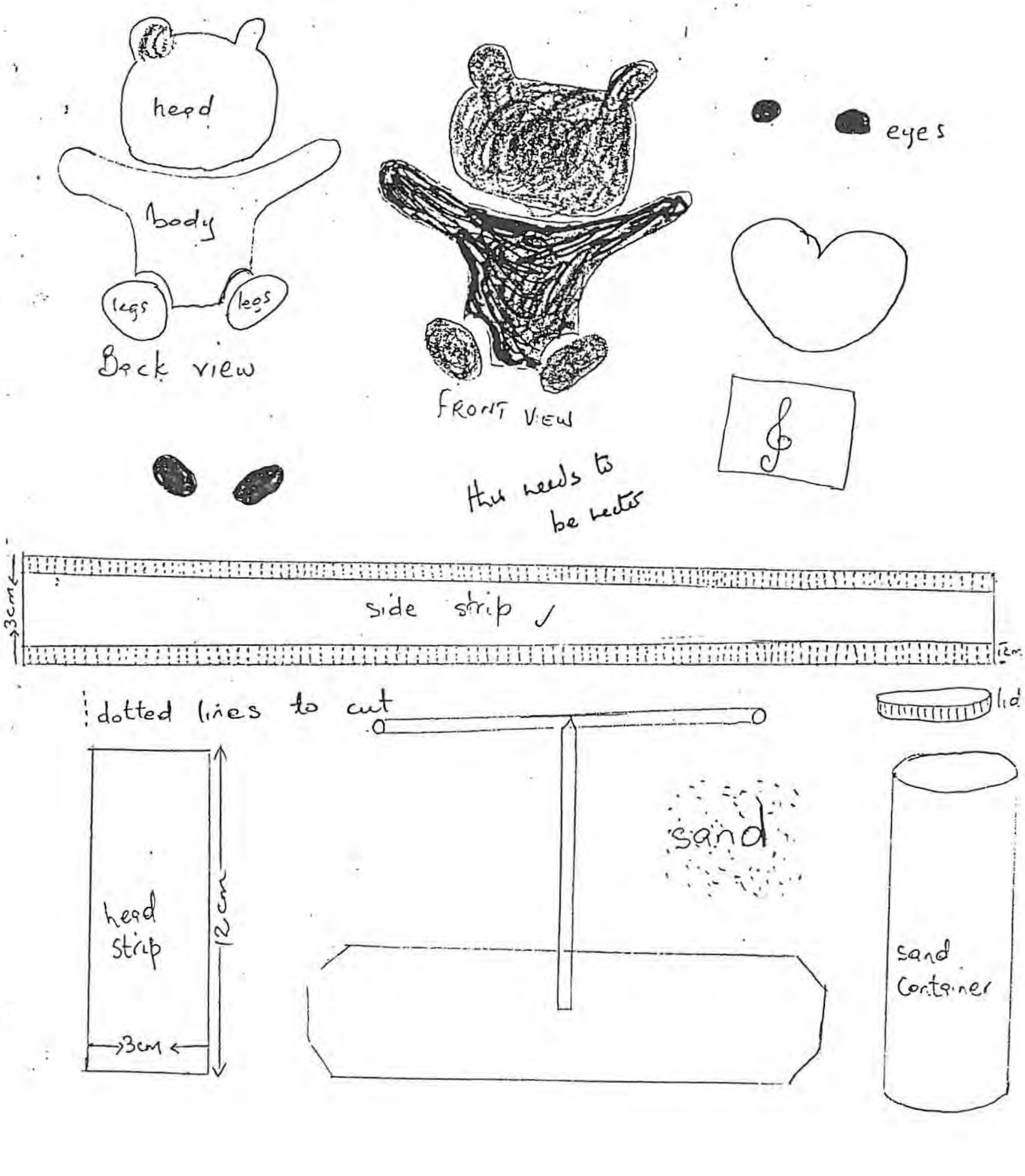




7. Preferred Solution



8. Working Drawings:



9. Construction Plan :- Colour all your parts first
take the side strip, bend the cutted part, paste
glue on the end of the front side of the head of the toy
contact these, do the same to the back side
of the head, take the front body and paste on
end side, take selotape to join the head and body
put the selotape inside, do the same on legs.
Put the eyes, nose on the head and draw the
mouth, put decorations on the body and
on the legs. Make a balancing scale with wood

10. Construct Prototypes

11. Testing / Evaluation
Put the toy on the other side of the
balance scale, then take the container
with sand and put on the other
side, the toy is hanged by its
head strip and the sand container
is hanged by the wool. The toy is
balancing, no problem
I suggest the addition of a frictional surface on
top of cross bar to prevent the mass pieces
falling off.

Assessment: Project 1/2000						
Name:	1-2	3-4	5-6	7-8	9-10	Score
The Portfolio and Project show evidence of:						
* 1. Well constructed textual information			~~8~~ 6			6
2. Good graphical presentation			6			6
3. Good prototype and final product				7		7
TOTAL						19
-10% per day for late submission. -20%						13

Comments: * Use red book as ref to improve this
Graphics "OK" but there is plenty of room for improvement - lines ⊥ & ॥ / text neatly printed/etc.
Well constructed product but in need of decoration.

Date: 4/8 Signature:

Mark Allocation Checklist

- Well constructed textual information

(0) No evidence of consideration to this aspect is given
(1 – 4) Minimal effort in construction of information, poorly presented, very untidy
(5 – 8) A reasonable attempt, but contains elements of error/poor presentation, some untidiness
(9 - 10) Well constructed body of text, accurate and neatly presented

- Good graphical presentation

(0) A very poor attempt at an incomplete presentation
(1 – 4) Very little effort has been put into making the graphical work presentable
(5 – 8) A reasonable presentation, but could be improved upon with more effort
(9 - 10) An outstanding graphical presentation, bearing in mind the skills provided by the lecturer

- Good prototype and final product

(0) No prototype or product submitted
(1 – 4) Poorly made artefacts, using very elementary skills
(5 – 8) Well made artefacts which could be improved with more effort
(9 - 10) A beautifully constructed and finished project, well done!

APPENDIX Z

An example of an inappropriate list of references

REFERENCES.

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SHUTER AND SHOOTER PIETERMARITZBURG 1999.

2. BARKER K et al, TECHNOLOGY TODAY,
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3 ELLIOT A; THE MAGIC WORLD OF THE XHOSA,
CHARLES' SCRIBNERS' SONS;, NEW YORK; 1970

4. FRANKEN J et al; SHUTER'S TECHNOLOGY
SHUTER AND SHOOTER PIETERMARITZBURG 1999

5 MPUQA B. O. 800 MSOBOMVU T/SHIP,
BUTTERWORTH.

6. DRUM MAGAZINE; NOVEMBER 2000.

7. YOUR FAMILY MAGAZINE, NOVEMBER 2000

APPENDIX AA

An example of a student's mini-research assignment

THE PROBLEM THAT MY LEARNERS HAVE IN MY LEARNING AREA.

INTRODUCTION

Asking a South african teacher to identify a problem in his classroom or learning area is one of the easiest jobs. This is because we as teachers are faced with these problems almost everyday but we take them as challenges.

THE PROBLEM

Having taught Mathematics for a number of years at Primary level, I have come to realise that one of the problems that our pupils encounter is to work with fractions.

It does not matter what approach I use, I still encounter the same problem.

Problem stated = 6.

The problem is clearly stated and evidence is reasonably clear. Perhaps you should inform me what the class is — I had to find it out myself

3. LINKING THEORY WITH PRACTICE

A. HOW WIDESPREAD IS THE PROBLEM

This is one of the major problems in Mathematics across the grades. It starts right from the introductory grades ie. grade 4 or 5 up to grade 12.

Some people say that its true that education is based on someones experience. The problem with fraction supports this learning theory because in our everyday life we live with wholes not fraction. There are few instances where we talk of fractions. Take for example when an old man in rural areas ask his son to count the sheep, goats, cattle etc. In that period there are adult sheep and their youngones but the young ones are not counted as halves or fractions.

So it is true that the education that is confined within the walls of the classroom is dead. What the child learns at school ~~who~~ should also feature in his real life situation. With fractions there are few cases where we work with fractions at home. The only familiar fractions to our ~~t~~ children are the halves, and quarters.

Mtshangase Lutho Grade 7MB Monday 29 May 200

a) $\frac{1}{2} + \frac{1}{4}$

$\frac{1}{2} + \frac{1}{4}$ Where is you LCM?

$= \frac{2}{6}$

$\frac{0}{5}$

b) $\frac{2}{3} \times 1\frac{2}{5}$

$\frac{2}{3} \times 1\frac{2}{5}$ change this to an improper fraction

$= 1\frac{4}{15} = 1\frac{4}{5}$

29/05/00

c) $4 - \frac{3}{4}$

4
$- \frac{3}{4}$
$= \frac{1}{4}$

d) $2\frac{2}{5} + 1\frac{1}{10}$

$2\frac{2}{5}$
$+ 1\frac{1}{10}$
$= 3\frac{3}{15}$

e) $\frac{1}{3} \div \frac{5}{10}$

$\frac{5}{10} \overline{)\frac{1}{3}}$

$= \frac{3}{2}$

Student examples = 2

INTERVENTION

(a) I would do some remedial teaching to those that I see are struggling very much. I would start by doing easy types of problems so as to build up their confidence in working with fraction

After they have understood the easy problems I would then try and do more difficult ones. I would also give them some problems to do at home and encourage their family members to help them when they experience some problems.

I think this will help because they will be doing these problems over and over, and I think the intervention of family members will also help them because some of them might try and devise knew methods of solving the problems.

INTERVENTION PROGRAMME

I would give them the easier problems to solve at first. The ones I knew will understand. eg

$$\frac{1}{4} + \frac{2}{4} = \frac{3}{4}$$

I will then try and do difficult ones where they have to work with different denominators eg. ✓

$$\frac{3}{8} - \frac{1}{4}$$

$$\frac{3\times1 - 1\times2}{8}$$

$$\frac{3-2}{8}$$

$$\frac{1}{8}$$

With problems of this nature I will then be able to see where the problem areas are. If there are still some problems I will then go back to step one ie the easier ones.

FINDINGS

I gave my pupils the following problems after my intervention programme. ✓

(a) $\frac{2}{6} + \frac{3}{6}$

(b) $\frac{2}{8} + \frac{1}{4}$

(c) $2\frac{1}{3} + 1\frac{1}{6}$

(d) $1 - \frac{1}{2}$

FINDING.

The intervention was not so effective I thought it would be. A few of my my pupils were able to grasp something from my intervention programme

Most of the did very poor as you can see from the scripts that I have collected from them.

Intervention = 20.

B: SOLUTIONS TRIED BY OTHER EDUCATORS

Most educators have resorted to the basics. By that I mean some educators have gone as far as having an apple or orange in class and these are cut up into various fractions to demonstrate this concept.

Others have observed that as the learning material intensifyse the problem crops up again. Some educators have tried to do these fractions the whole year.

RECOMMENDATIONS AND CONCLUSION

Some have suggested that these fractions should be introduced at an early stage, to the learners. Other educators recommend that the part of work that deals with fractions should be done throughout the year.

CONCLUSION

My conclusion is that educators across the education fraternity need to have a look at this problem especially in the primary level.

Conclusion = 1/6

The Education mini-research assignment and assessment criteria

FDE 2 EDUCATION - 2000

Research Assignment

This research assignment has four parts. Its aims are to:

- develop your skills of observation in identifying a problem,
- analyse and test a situation,
- use theory to support your thinking and
- recommend remedial action

There are four parts :

1. Identify and collect evidence of a problem
   (a) Identify a problem that your learners (or some of them) have in learning your subject [e.g. in Biology Grade 12 it is neurons or hormonal co-ordination or population dynamics]
   (b) Bring examples of your learner's work to support you claim.

2. Intervention
   (a) *Think about* what you could do to help your learners overcome the problem and say why you think this will help.
   (b) *Design* a short intervention programme to solve the problem.
   (c) *Carry out* the intervention and bring examples of learners' work
   (d) Reflect on how effective (or not) your intervention was - *findings.*

3. Linking theory with practice
   Do a literature search to answer the following questions (or ask other educators)
   (a) How widespread is the problem I have identified?
   (b) What solutions have other educators tried?
   (These may have to be more general - looking at learning theories)

4. Recommendations and conclusion
   Order your write up to put 3 in with 1 and 2 and then complete it by adding recommendations and a conclusion which should include your thoughts on how you did the research and what you might have done differently.

(ADC will help with stages 3 and 4)

MEMORANDUM - FDE 2 - EDUCATION - RESEARCH ASSIGNMENT

to be shared on Saturday 7 October

- This was intended to be a developmental assignment in four separate parts. Each was supposed to be handed in during the course of the year but there were logistical difficulties and it was negotiated with each class that the Research Assignment in its completed form would be handed in at the end.

- The "end" is Saturday 4 November

- All four parts of the completed presentation must be submitted on Saturday 4 November for assessment.

  NO LATE SUBMISSIONS WILL BE ACCEPTED

- The structure of four parts must be clearly presented as each part will be marked separately [details of what is needed for each part have been given in an earlier handout] :

Part	*Marks allocated*
1. Identify and collect evidence of a problem	10
2. Intervention	20
3. Linking theory with practice	30
4. Recommendations and conclusion	40

APPENDIX CC

The NGO branch fee payment agreement

4 March 2000

Fees Commitment 2000

Please Print Neatly

I (First name / Surname): ....

Student Number: ....

understand and acknowledge that I shall have to pay the tuition fees in the amount of R 3 000.00 for the calendar year 2000. In addition, I will pay R 800.00 for materials, resources and photostats issued to me in 2000. I understand that I may, after consultation and agreement with my lecturers, and in addition to the above, be requested to purchase additional equipment, materials, resources and reference texts which may aid my education.

I understand that my Year 2000 Minimum Initial Payment (MIP) of R 1000.00 is broken up as follows:

First Fees Instalment	R 200.00
Materials & Resources	R 800.00
TOTAL	R 1000.00

I accept that the following conditions will apply:

I will be requested to pay the a further nine instalments of R 300.00 per month for April through November 2000, and one R 100.00 instalment in December 2000. Each instalment becomes due on the 1st day of each month. My next instalment is due on 1 April 2000.

I understand and accept that the policy is that, in cases where students fall into arrears in their fees repayment, said students are barred from attending classes until full settlement of the arrears account is made.

I further understand and accept that University will not disclose my final examination results unless my account is paid in full, and that I will not be able to graduate as a result of this.

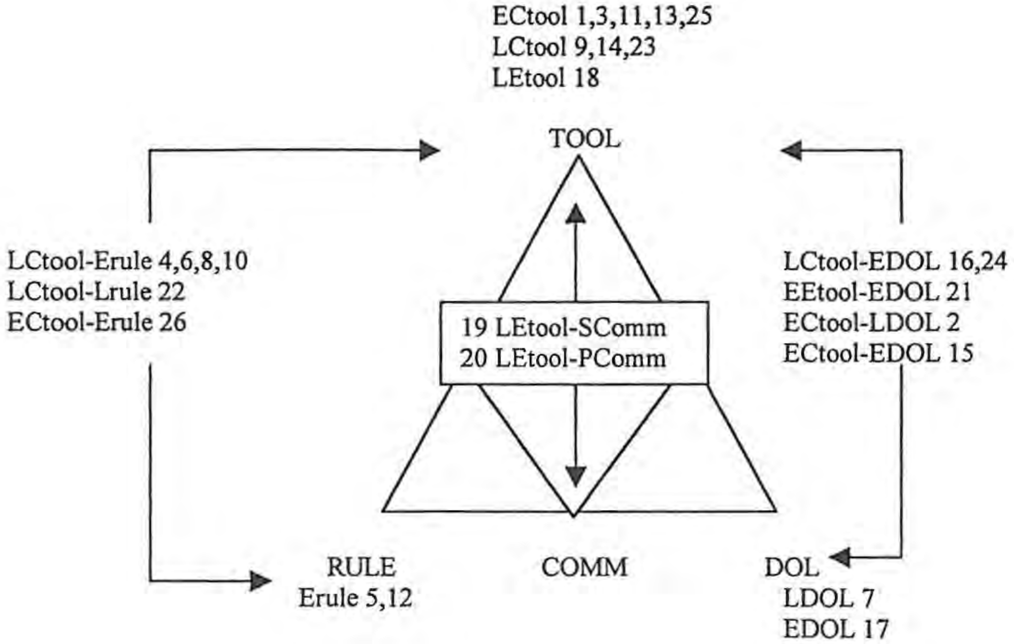
I also understand and accept that having signed this document, I become liable for the full fee and materials costs, that no part of the above fees and costs is refundable, and that should I default, the will take all necessary steps to recover outstanding fees and costs.

A similar arrangement, with a possible inclusion of an additional 10% for escalation in costs for tuition fees and materials, resources and photostats will commence in January 2001.

SIGNED.. DATE..

APPENDIX DD

The Lesson B Activity System contradictions



1. The educator (subject) does not pose a problem appropriate for Grade 7 learners (ECtool)

2. The learners (subjects) are not able to engage with the problem (LDOL) since it is poorly conceptualised (ECtool)

3. The educator does not adequately conceptualise 'problem solving' (ECtool)

4. The educator (subject) does not mediate (Erule) when the learners identify the problem as the "scary animal" (LCtool)

5. The educator (subject) is unrealistic to suggest one minute for the discussion (Erule) and has to adjust the time so that the learners can complete the task

6. Learners (subjects) speak Xhosa in groups (LCtool) and not English (Erule)

7. Some learners (subjects) are not prepared to share their ideas (LDOL)

8. The learners (subjects) write in English (Erule) and discuss in groups in Xhosa (LCtool)

9. The learners (subjects) offer solutions (LCtool) that do not solve the problem identified as the 'scary animal'

10. The educator (subject) does not challenge all the learners' solutions (Erule) that are inappropriate (LCtool)

11. The educator (subject) misinterprets "go around the river" and says that the goats will drown if they try to cross the river (ECtool)

12. The learners (subjects) talk while other learners are talking (Erule) so the others cannot hear their ideas

13. The educator (subject) does not apply the steps in problem solving fully (ECtool)

14. The learners (subjects) do not consider the possible solutions critically as suggested in problem solving (LCtool)

15. The educator chooses the best solution (EDOL) for the learners without investigating pros and cons of possible solutions (ECtool)

16. The educator (subject) does not teach the skills (EDOL) for the learners to 'design' (LCtool)

17. The educator (subject) over rules the learners' wishes (EDOL) and tells them to work individually instead of in a group

18. The learners (subjects) do not have pencils and erasers (LEtool)

19. The learners (subjects) borrow equipment (LEtool) from other learners in other classes (SComm)

20. The parents (PComm) do not/cannot provide pens, pencils, erasers, rulers (LEtool)

21. The educator (subject) has a textbook (EEtool) but does not refer to it (EDOL)

22. The learners (subjects) are not using their creativity (LCtool) but rather copy each other's work (Lrule) and hence do not develop the skills necessary for designing

23. The learners (subjects) design inappropriate "sponges" because they do not know what the hoof of a goat looks like (LCtool)

24. The educator (subject) does not tell the learners (EDOL) that their designs are inappropriate (LCtool)

25. The educator (subject) does not plan his lesson effectively (ECtool) and there is not enough time to complete the tasks during the lesson

26. The educator (subject) speaks to the learners in Xhosa (ECtool) and not English (Erule)

Educator A's 'best work' with regards to the technological process

SITUATION :- Three villages in the former Transkei region have been damaged by a tonado. The houses roofs are the most affected, what can you do to rescue this situation. Bear in mind that the community is demanding an Immediate action.

ANALYSIS OF SITUATION :- I think the problem is how they built their homes? How are the houses situated / in which way are they facing. How are the roofs built? What type of material did they use? Who was building the house? You go and Research.

BRIEF :- Design and make a strong and safe roof for the houses of 3 villages that were damaged by a tonado.

RESEARCH :- I visited the area, I tried to get as much information as possible, I met builders of the area, Also I met some experienced Technologists, I met Traditional leaders of this area to tell me more about the area and its changing weather. Building shops for material, Examining the remaining roofs,

SPECIFICATION :- The roof we are making is a prototype of of the original Copy, The roof is made from strong wood and Nails. It must be well built, acording to the size of these houses. It must be straight without bending or having sharp corners.

SPECIFICATION :- The format of the roof must be a strong Triangulation format. This frame structure must be completed within a month from now. I will need (Planks / boards, saw, glue, nails, tapemeasure, Wood electric glue / Try to make use of waste material. The length must be 10 cm; Width = 5 cm and height = 2 cm. Bear in mind to handle tools with care.

POSSIBLE SOLUTIONS :- I brainstormed with other technologist around the issue of building the roof, whether the roof will be a flat or it will be a normal roof. If the previous roof was built higher than this then let us make sure that this one is realy something better than the one that was damaged. It must be anchored and strengthened by building a triangular format in between the roof. Build a more balanced flat roof with triangular balancing taking place on the frame of a roof.

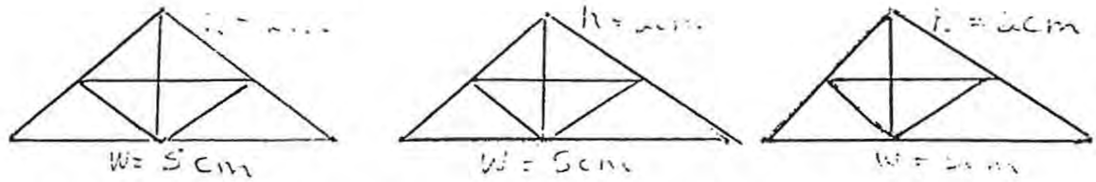
PREFERED SOLUTION :- Building a more balanced flat roof with triangulation helping to balance the roof.

NB It must be reliable and convenient to count against tonados and thunderstorms.

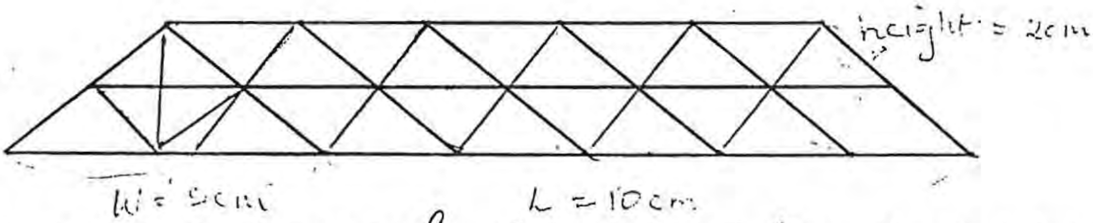
CONSTRUCTION PLAN :- The Length = 50 cm ; Width = 18 cm height = 25cm. Measure the small planks and place them in a flat place. Once you are sure with sizes glue the small planks as per initial arrangement. Make sure that you have glued them correctly and allow the glue to cool down without any disturbance, for good results.

WORKING DRAWING :- I will need a saw, wood glue, tape Measure, the actual Plan for the roof and assistance from the facilitator. I will also need a lead and a little humer.

THE PIECES OF FRAME FOUND INBETWEEN THE BIGGER ROOF TRIANGULATION PIECES



THE FRONT AND SIDE VIEW OF THE ROOF



TESTING AND EVALUATION :- I will check whether the product satisfies the requirements or not. I will make sure that I measure it up again. I will also make sure that it is dry and it is sunded correctly and smoothly around the corners. Make sure that the wood glue is neatly paisted. I will check whether I spend my time correctly? I will use SWOT analysis to asses it which means I will look at my strengths, weakneses, opportunities and Threats. I will look at the problems that I encountered and try to improve on them. I will let the peers to asses it and compare it with theirs. Will it work well? Is it reliable for use? Let affected People asses it -

WRITE a REPORT

From the situation I could read that most of the houses are affected on the roofs, which states it clearly that there's a problem with their roofs or the place in which they build their houses in. The direction in which the houses are facing.

I think and feel this project is worthwhile and convenient because it is flat, built with strong material, It is reinforced by the triangulation format inbetween. I have met stakeholders and traditional leaders for approval.

Brief :- I sat down and analyse the problem, from that step I could study that people in rural areas use cheap wood for construction of their roofs. They also don't have qualified builders as a result they built high roofs that are exposed to strong winds.

This information helped me because I decided to look at best solution.

RESEARCH :- I approached the problem because I have analysed the problem and the type research that I have undertaken I find out that the material used was not good, the direction of the houses, most damage is on the roofs. Other technologist helped me in my construction and I feel the plan helped me as well. The various solutions have been put in place and discussed and they helped me in getting into the best solution.

Best Solution :- Designing of just a flat roof wouldn't result anywhere, but because of the triangular format inbetween it makes it very strong and yet convenient.

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Information regarding the citation of documents from the NGO and the University may be obtained from the author.

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